CRM 88-167 / April 1989



# RESEARCH MEMORANDUM

# ESTIMATION OF MPN OBLIGATIONS

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A Division of CNA Hudson Institute

CENTER FOR NAVAL ANALYSES

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This research memorandum describes an analysis of methods that will enable OP-01 to monitor more closely the execution of the MPN appropriation. In particular, the analysis is concerned with the identifcation of leading indicators of MPN obligations that provide accurate forecasts of fiscal year obligations within a few months of the fiscal year's start. The study demonstrates that succinct and accurate estimation techniques may be applied to basic pay, retired pay accrual, basic allowance for quarters, FICA, and officer basic allowance for subsistence. Other pay catagories exhibit too much irregularity to be amenable to such forecasting methods. The analysis exhibits the margins of error that apply to the forecasts and are inherent in the Navy's information systems.

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1. This research memorandum represents the final documentation of a CNA project request by the Assistant Deputy Chief of Naval Operations (Manpower, Personnel and Training) (OP-01). It documents analyses of methods that provide Navy management a top-level monitoring capability with respect to the execution of the MPN appropriation. In particular, analysis is focused on the identification of leading indicators of MPN obligations that provide accurate forecasts of fiscal year obligations within a few months of the fiscal year's start.

The study demonstrates that succinct and accurate estimation methods may be applied to only some of the so called "strength-related" pay categories within the MPN account. In particular, a knowledge of strength plans provides reasonably accurate estimates of obligations for basic pay, retired pay accrual, basic allowance for quarters, and FICA for both officers and enlisted personnel, and officer basic allowance for subsistence.

2. Enclosure (1) is forwarded as a matter of possible interest.

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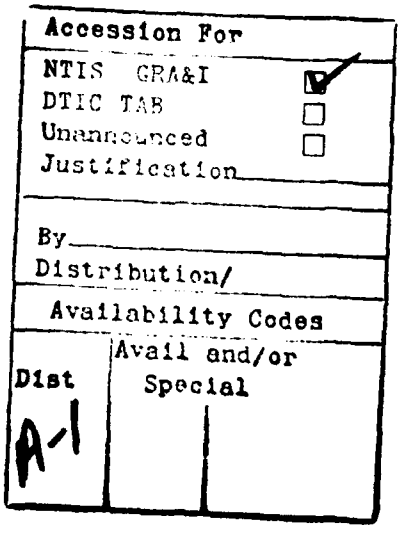
This research memorandum describes an analysis of methods that will enable OP-01 to monitor more closely the execution of the MPN appropriation. In particular, the analysis is concerned with the identification of leading indicators of MPN obligations that provide accurate forecasts of fiscal year obligations within a few months of the fiscal year's start. The study demonstrates that succinct and accurate estimation techniques may be applied to basic pay, retired pay accrual, basic allowance for quarters, FICA, and officer basic allowance for subsistence. Other pay categories exhibit too much irregularity to be amenable to such forecasting methods. The analysis exhibits the margins of error that apply to the forecasts and are inherent in the Navy's information systems.



## EXECUTIVE SUMMARY

Management of the execution of the Military Personnel Navy (MPN) appropriation is a complex and difficult task. Navy managers attempt to precisely control the expenditures of a $17 billion account for which it is illegal to obligate more than Congress authorizes. The ability to accomplish this task is directly related to the timeliness and accuracy of data describing current-year MPN expenditures. It is usually uncertain until well into a fiscal year whether execution is on track. At that time the Navy may have to take action to bring expenditures into line with appropriation levels. The options available to Navy managers for the control of MPN expenditures diminish as the fiscal year progresses. Moreover, the small number of options available during the latter months in a fiscal year tend to be disruptive to Navy personnel management. The earlier in a fiscal year the Navy can be aware that MPN execution is awry, the more efficiently and easily corrective actions can be taken.

This report describes an analysis of methods that will enable OP-01 to monitor more closely the execution of the MPN appropriation. In particular, the analysis is concerned with the identification of leading indicators of MPN obligations that provide accurate forecasts of fiscal year obligations within a few months of the fiscal year's start. The objective of the study has been to provide Navy management a top-level monitoring capability with regards to the MPN account. The management of line items within the MPN appropriation is carried out by several offices within OP-01 and NMPC. The Navy uses a variety of large and complex models in managing the various items in the MPN account. For example, OP-136 employs several models to manage just the SRB appropriation. The results of this analysis in no way substitute for such detailed effort. Instead, the analysis has been confined to methods that could be implemented on a microcomputer, and preferably on a spreadsheet.

MPN execution may differ from planned levels for at least two reasons: discrepancies may arise between obligations and expenditures, and the strength plans underlying the MPN appropriation may differ from the actual inventory that evolves. The former situation is mostly caused by accounting problems and has been the subject of much study. This study addresses the latter situation where strength plans prove to be inaccurate.

The study demonstrates that succinct and accurate estimation methods may be applied to only some of the so called "strength-related" pay categories within the MPN account. In particular, it is possible to obtain reasonably accurate estimates of a variety of pay categories based upon knowledge of strength plans. The pay categories that are open to such an estimation process are basic pay, retired pay accrual (RPA), basic allowance for quarters (BAQ), FICA, and officer basic allowance for subsistence (BAS). Other pay categories exhibit too much irregularity to be amenable to such forecasting methods.

The value of the above estimation techniques is magnified by the size of the pay categories that are addressed. Basic pay, RPA, BAQ, and FICA account for more than 82 percent of total

MPN obligations. Consequently, the majority of the MPN account is amenable to succinct analysis.

From both practical and statistical standpoints, the estimation methods are as accurate as one can expect to obtain. The estimation techniques provide confidence intervals that are frequently less than 1 percent of obligations. For example, in a three-month forecast of enlisted basic pay, one has 95 percent confidence that the forecast will be within $16 million of the actual value. Three months of enlisted basic pay obligations amount to approximately $1.5 billion. Due to the complexity of the Navy's information systems, one could not expect any greater precision.

It is illegal for the Navy to overexpend authorizations. Consequently, strength and budget plans should err on the side of caution. It makes more sense to plan for a marginal under-obligation of authorized funds and make adjustments as the year progresses than to plan to spend every dime that is authorized. Navy managers may save money by varying the timing of losses, gains, and promotions. In previous years, it was a common practice for strength plans to contain some slack in planned promotions, accessions, and losses, which could be the source of money savings if necessary. With recent budget constraints, this flexibility seems to be drying up. Unfortunately, this takes away required leeway and forces undesirable management decisions if events do not precisely follow plans.

The study led to the opinion that the Navy could take at least two actions to better manage the MPN account. The first option concerns the somewhat fragmented manner in which Navy personnel managers operate. The management of the MPN account requires the knowledge and inputs of many organizations within OP-01 and NMPC. Historically, these organizations have operated independently and have come together only once a month in order to present a briefing to the Chief of Naval Personnel. The recent organizational changes within OP-13 geared to instituting an office responsible for coordinating the management of MPN account execution, are to be applauded. Its implementation should facilitate gathering the disparate information needed in this area.

In addition, the Navy should consider the adequacy of the information that is being provided to managers of the MPN account. For example, estimation of VHA obligations is inhibited by a lack of software that would compute such obligations from a geographical distribution of personnel and VHA rate tables. One suspects that ADP support could be improved in a number of areas. Because this area cuts across many organizations, the establishment of a coordinating function within OP-13 might help bring such problems to light.

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# INTRODUCTION

Managing the execution of the Military Personnel Navy (MPN) appropriation is complex and difficult. Navy managers attempt to precisely control the expenditures of a $17 billion account for which it is illegal to obligate more than Congress authorizes. The ability to accomplish this task is directly related to the timeliness and accuracy of data describing current-year MPN expenditures. It is usually uncertain until well into a fiscal year whether execution is on track. At that time the Navy may have to take action to bring expenditures into line with appropriation levels. The options available to Navy managers for the control of MPN expenditures diminish as the fiscal year progresses. Moreover, the small number of options available during the latter months in a fiscal year tend to be disruptive to Navy personnel management. The earlier in a fiscal year the Navy can be aware that MPN execution is awry, the more efficiently and easily corrective actions can be taken.

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Execution of the MPN appropriation may differ from planned levels for at least two reasons: discrepancies may arise between obligations and expenditures, and the strength plans underlying the MPN appropriation may differ from the actual inventory that evolves. The former situation is mostly caused by accounting problems and has been the subject of much study. Indeed, recent work by the Navy Personnel Research and Development Center (NPRDC) has provided the Naval Military Personnel Command (NMPC) with a means of projecting and accounting for differences between obligations and expenditures [1]. This study addresses the latter situation, in which strength plans prove to be inaccurate.

The MPN appropriation provides for the many costs associated with paying and moving Navy personnel. It is a large item in the Navy's total budget and is constantly subject to review by the Navy, the Office of the Secretary of Defense (OSD), and Congress. In particular, in a time of tight budgets, attempts to save money by cutting personnel costs are frequent. The level of MPN obligations depends upon many factors, and small changes in any of these can have a significant impact on obligations. For example, a small change in continuation rates could lead to obligations varying by millions of dollars. This research memorandum demonstrates the

importance of having accurate projections of such factors as continuation rates in the planning process. It also describes a capability to compute the fiscal impact of deviations from planned levels.

The MPN account differs from the majority of the Navy's budget in a fundamental way. Most of the Navy's budget is controlled by contracts that prohibit spending money without the explicit authorization of the government. Personnel costs are different. Navy personnel are entitled to be paid regardless of authorization limits. The many personnel actions that directly bear on MPN obligations (e.g., recruiting, promotions, reenlistments) are managed at a macro level, where broad guidelines are set to ensure compliance with appropriation limits. However, the attained levels of these parameters vary greatly as one moves around the Navy. This situation is inevitable, given the nature of our volunteer force. Consequently, obligation levels cannot be exactly prescribed. Given the illegality of exceeding appropriation levels, a prudent manager of the MPN account might allow for a margin of error in budgets, thus minimizing the possibility of overspending the account. However, such an approach means that dollars may go unspent at the end of the fiscal year. These unspent dollars will be a direct consequence of not having authorized levels of personnel in the Navy, which is clearly not satisfactory. Thus, in many ways, the management of the MPN account involves deciding how close one can plan to meet authorized personnel levels without risking overexpenditures. The accuracy of pertinent forecasts is obviously a major factor in this process. This research memorandum addresses these issues and may help the Navy in managing the execution of the MPN account.

The report begins with a review of the MPN account, describing trends plus its size and content. The next section analyzes methods of obtaining forecasts of items within the MPN account. The MPN account may be divided into two parts: items that are strength related (e.g., basic pay and social security tax, (i.e., FICA)) and other budget items (e.g., incentive pays and PCS costs). For a variety of reasons the primary focus of the analysis is on the strength-related items. Strength-related obligations amount to more than 80 percent of the MPN account and are comparatively easy to predict, being a direct consequence of inventories. Non-strength-related obligations are harder to predict, requiring strength-related data plus information relating to the precise budget item under consideration. For example, overseas station allowance obligations are based not only on numbers of personnel overseas but also on currency exchange rates. In addition, non-strength-related obligations are much more amenable to being rapidly constrained by Navy managers and, as such, tend to be used as a means of keeping overall MPN obligations within appropriation levels. Consequently, non-strength-related obligation levels are often a reaction to a policy action taken to correct budgeting problems, thus making them difficult to predict.

The report continues with a review of the MPN appropriation for FY 1987. The execution of the 1987 appropriation was fraught with problems, and the Navy had difficulty in keeping expenditures within obligation levels. A variety of strength plans for the 1987 budget are reviewed, and conclusions are reached regarding some causes of the difficulties. The next section contains a similar analysis of the FY 1988 MPN account. The report finally offers conclusions and recommendations.

## OVERVIEW OF MPN ACCOUNT

The following description of the MPN account should enable one to view the relative and absolute magnitude of the various categories of obligations. A useful starting point is the size of the account and corresponding inventory sizes and how they have varied in recent years. Table 1 contains the relevant data.

**Table 1.** Historical inventories and obligations

| Fiscal year | MPN obligations ($ millions) | End strength | |
|---|---|---|---|
| | | Officer | Enlisted |
| 1983 | 10,916 | 68,494 | 484,568 |
| 1984 | 11,522 | 68,856 | 491,288 |
| 1985 | 16,112 | 70,657 | 495,444 |
| 1986 | 16,936 | 72,051 | 504,389 |
| 1987 | 17,794 | 72,051 | 510,026 |

The large increase in MPN obligations in 1985 was caused by the addition of retirement accrual to the MPN account. The following tables, which describe details of obligations in 1987, reveal the composition of the MPN account. Table 2 shows the division of obligations into major categories.

**Table 2.** FY 1987 obligations

| Budget category | ($ millions) | Percentage of obligation |
|---|---|---|
| Officer pay and allowances | 4,156 | 23.5 |
| Enlisted pay and allowances | 12,157 | 68.8 |
| Cadets/midshipmen pay and allowances | 36 | 0.2 |
| Enlisted subsistence | 758 | 4.3 |
| Permanent change-of-station costs | 517 | 2.9 |
| Other | 45 | 0.3 |
| Total | 17,669 | |
| Reimbursables | 124 | |

The categories in table 2 come from official budget submissions. In these documents, officer subsistence obligations are part of officer pay and allowances, whereas they are displayed separately for enlisted subsistence. The category "Other" covers such items as unemployment compensation and the cost of apprehending deserters. Finally, total obligations are partially offset by amounts that are reimbursable from other government accounts. The magnitude of reimbursables is fairly stable, and the 1987 level was representative. The pay and allowance categories can be further subdivided as shown in tables 3 and 4.

**Table 3.** FY 1987 officer pay and allowances

| Category subdivision | ($ millions) | Percentage of obligation |
|---|---|---|
| Basic pay | 2,098 | 50.5 |
| Retired pay accrual | 1,099 | 26.4 |
| Basic allowance for quarters | 307 | 7.4 |
| Variable housing allowance | 118 | 2.8 |
| Social security tax | 149 | 3.6 |
| Basic allowance for subsistence | 97 | 2.3 |
| Incentive pay | 95 | 2.3 |
| Special pay | 117 | 2.8 |
| Other | 76 | 1.8 |
| Total | 4,156 | |

**Table 4.** FY 1987 enlisted pay and allowances

| Category subdivision | ($ millions) | Percentage of obligation |
|---|---|---|
| Basic pay | 6,243 | 51.4 |
| Retired pay accrual | 3,265 | 26.9 |
| Basic allowance for quarters | 899 | 7.4 |
| Variable housing allowance | 298 | 2.5 |
| Social security tax | 443 | 3.6 |
| Incentive pay | 93 | 0.8 |
| Special pay | 259 | 2.1 |
| Special duty assignment pay | 51 | 0.4 |
| Enlistment bonus | 12 | 0.1 |
| Reenlistment bonus | 233 | 1.9 |
| Other | 361 | 3.0 |
| Total | 12,157 | |

The category "Other" in tables 3 and 4 includes such items as overseas station allowances and family separation allowances. It can be seen from these two tables that a few of the pay categories account for the preponderance of the obligations. In particular, basic pay and retired pay accrual (RPA) account for almost 78 percent of pay and allowance obligations and 72 percent of the entire MPN account. This observation is central to the management of the MPN account. If pay and allowance obligations are well managed, then the MPN account, as a whole, will probably be in good shape. In addition, various items in the MPN account will be directly proportional to basic pay obligations. For example, social security payments are a fixed percentage of basic pay. Consequently, accurate management of basic pay will have a "multiplier effect" on the overall management of the MPN appropriation.

# MODELS FOR MPN OBLIGATIONS

## INTRODUCTION

The efforts undertaken to obtain forecasts of MPN obligations are described in this section. The analysis was guided by the aforementioned considerations concerning a few MPN line items being responsible for a majority of obligations. The line items were divided into "strength-related" and "non-strength-related" groups, in the same fashion as the monthly MPN briefing to OP-01. The strength-related items are displayed in table 5.

**Table 5.** MPN strength-related items

| Cost category | Officer | Enlisted |
|---|---|---|
| Basic pay | * | * |
| Retired pay accrual | * | * |
| Basic allowance for quarters | * | * |
| Variable housing allowance | * | * |
| Social security tax | * | * |
| Subsistence allowance | * | – |

Enlisted subsistence is not part of these strength-related items. This follows the anomaly with the categorization of enlisted subsistence, as noted in the previous section. The designation of an obligation as being related to strength connotes that it should be determined by inventory or, possibly, be proportional to basic pay. The analysis of these strength-related items focused upon a determination of whether such suppositions are justified, and if so, forecasting models were estimated. Enlisted subsistence was included in the analysis in order to be consistent between officers and enlisted personnel. Non-strength-related items were also analyzed with an aim towards obtaining estimating techniques that could be implemented on a microcomputer.

## STRENGTH-RELATED OBLIGATIONS

### Historical Inventories

The analysis of strength-related obligations was based upon monthly data for FY 1983 to FY 1987. In theory, estimating such items as basic pay obligations should be a very precise, if not deterministic, process if one has accurate knowledge of inventories. So, the analysis starts with a look at inventories. Figures 1 and 2 exhibit monthly endstrengths for officers and enlisted personnel, respectively. The figures display the inventory growth that occurred from 1983 to 1987. The distribution of the inventory by pay grade and length of service is required before pay

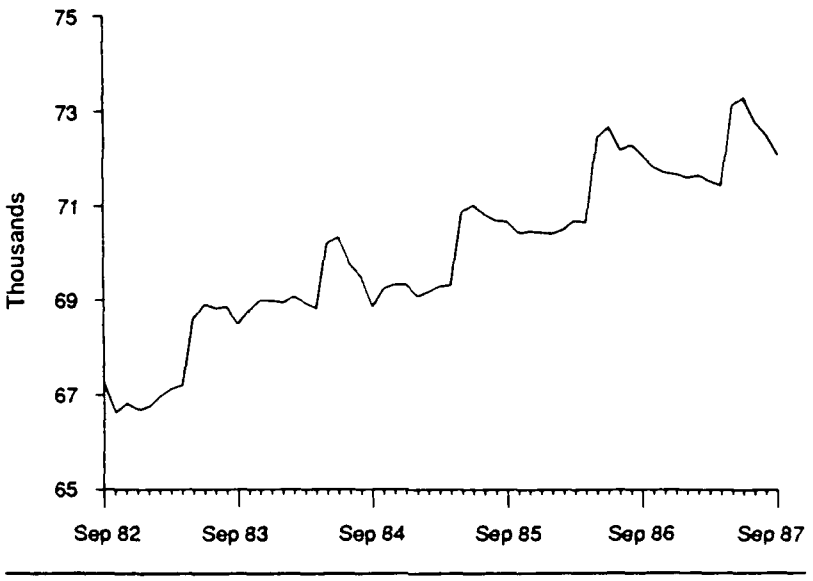


**Figure 1.** Officer end strength

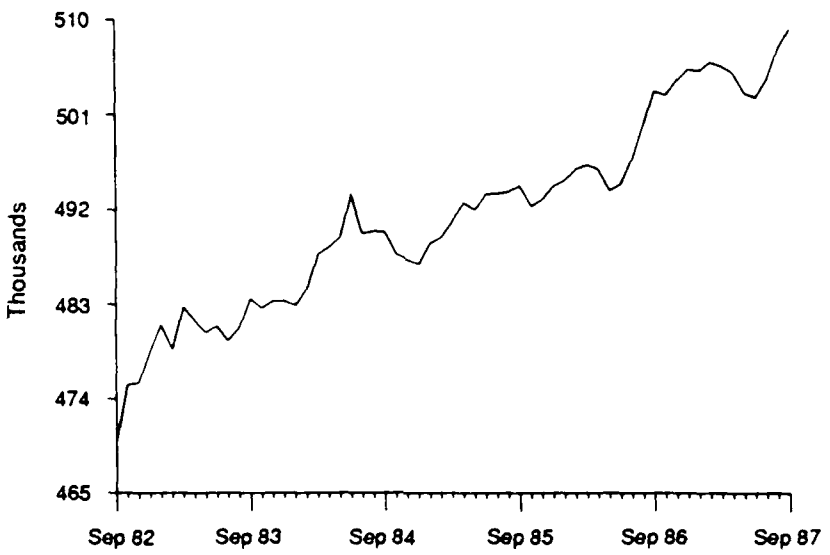


**Figure 2.** Enlisted end strength

obligations can be completed. These data are rather voluminous and so they are displayed separately in appendix A. Tables 6 and 7 summarize that appendix.

**Table 6.** Officer pay grade distributions

| | Percent | | | | | |
|---|---|---|---|---|---|---|
| Pay grade | Sep 82 | Sep 83 | Sep 84 | Sep 85 | Sep 86 | Sep 87 |
| O-7 + | 0.37 | 0.36 | 0.37 | 0.35 | 0.35 | 0.35 |
| O-6 | 5.66 | 5.48 | 5.38 | 5.24 | 5.15 | 5.10 |
| O-5 | 11.52 | 11.20 | 11.08 | 10.99 | 10.78 | 10.83 |
| O-4 | 19.23 | 18.65 | 18.67 | 18.60 | 18.57 | 18.22 |
| O-3 | 28.28 | 29.47 | 30.86 | 31.20 | 31.13 | 32.91 |
| O-2 | 15.26 | 15.45 | 15.37 | 14.83 | 13.44 | 13.11 |
| O-1 | 15.34 | 14.95 | 13.80 | 14.32 | 16.23 | 15.36 |
| W-4 | 0.68 | 0.88 | 1.37 | 1.53 | 1.56 | 1.44 |
| W-3 | 1.85 | 1.89 | 1.42 | 1.19 | 1.12 | 1.19 |
| W-2 | 1.78 | 1.67 | 1.69 | 1.75 | 1.66 | 1.50 |

**Table 7.** Enlisted pay grade distributions

| | Percent | | | | | |
|---|---|---|---|---|---|---|
| Pay grade | Sep 82 | Sep 83 | Sep 84 | Sep 85 | Sep 86 | Sep 87 |
| E-9 | 0.78 | 0.78 | 0.83 | 0.91 | 0.96 | 0.91 |
| E-8 | 1.80 | 1.85 | 1.81 | 1.98 | 1.99 | 2.04 |
| E-7 | 6.42 | 6.28 | 6.27 | 6.65 | 6.62 | 6.63 |
| E-6 | 13.82 | 13.97 | 14.94 | 15.81 | 15.69 | 15.88 |
| E-5 | 18.70 | 19.78 | 19.95 | 21.02 | 20.31 | 20.06 |
| E-4 | 21.68 | 22.76 | 21.55 | 21.16 | 21.40 | 21.16 |
| E-3 | 18.82 | 18.26 | 19.74 | 16.94 | 16.67 | 16.99 |
| E-2 | 9.90 | 9.16 | 7.63 | 8.18 | 8.44 | 8.99 |
| E-1 | 8.09 | 7.15 | 7.29 | 7.36 | 7.94 | 7.34 |

Evidently, pay grade distribution has changed in numerous ways between 1983 and 1987. One can see an increased percentage of lieutenants (O-3s) at the expense of other grades, and an increased percentage of senior warrant officers (W-4s) while the percentage of W-3s has declined. With regard to enlisted personnel, one can see that the inventory has steadily increased

in seniority. More detailed inventory distribution data are used during the estimation process, as will be described below.

Precise computation of pay obligations requires average onboard counts. However, historical inventory data were used for two reasons. First, average monthly strength counts were not readily available from the enlisted strength planners. Second, the data were used to build models for the estimation of pay obligations. These models will be used to forecast obligations that arise from strength plans. Strength plans are based upon monthly end strengths. So, in order to be consistent with the forecast input data, it was appropriate to use end strength as opposed to average strength data.

**Correlation of Cost Categories**

The analysis begins with an investigation of the correlation between the various "strength-related" pay categories and inventories for both officers and enlisted personnel. The pay categories are listed in table 5, above, and include basic pay, RPA, basic allowance for quarters (BAQ), variable housing allowance (VHA), FICA, and basic allowance for subsistence (BAS). Monthly obligations for these pay items are displayed in figures 3 through 14. The actual data are tabulated in appendix B.

Figure 4 reflects the fact that retired pay accrual became part of the MPN appropriation in FY 1985. Figure 14 displays data for enlisted BAS and subsistence in kind (SIK). The complementary nature of these allowances makes it natural to consider them jointly. All of the data in figures 3 through 8 exhibit growth over time. However, this is to be expected from pay raises. Closer examination reveals substantial variation in the data. For example, basic pay, BAQ, and BAS data exhibit large fluctuations near the end of FY 1984. The FICA, RPA, and VHA data also exhibit large variations at certain points in time. Evidently, MPN obligations do not maintain fairly constant values from one month to the next. Accurate models of obligations will need to capture these monthly variations. All the models described below have the following underlying idea: strength-related obligations may be estimated from knowledge of either inventories or basic pay. For example, one model estimated basic pay obligations directly from inventory data. RPA obligations are estimated to be a fixed percentage of basic pay, following budget guidelines. The correlation between the various strength-related pay items and inventory provides an initial indication of the probable success of this approach. Tables 8 and 9 exhibit various correlation coefficients.

The correlation between the different variables in tables 8 and 9 is substantial. However, the independent variation between the different officer pay items and strength is still significant.

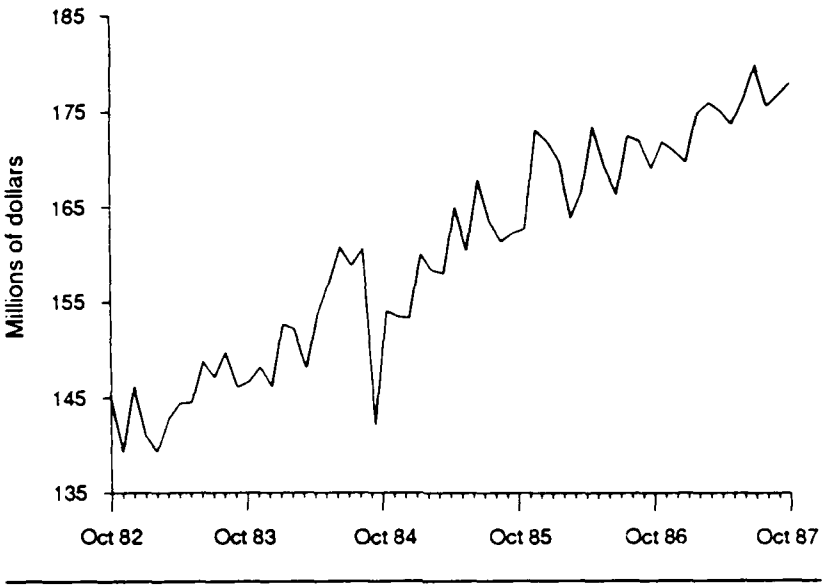


**Figure 3.** *Officer* basic pay obligations

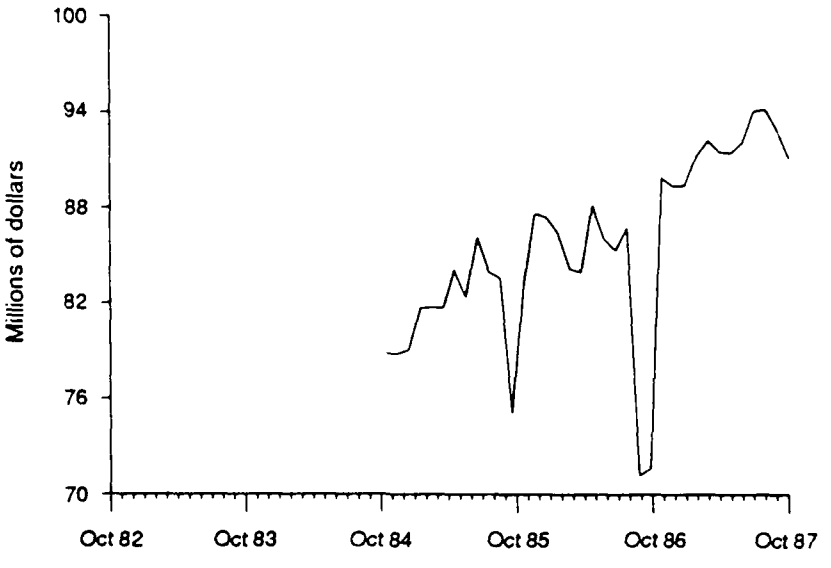


**Figure 4.** Officer RPA obligations

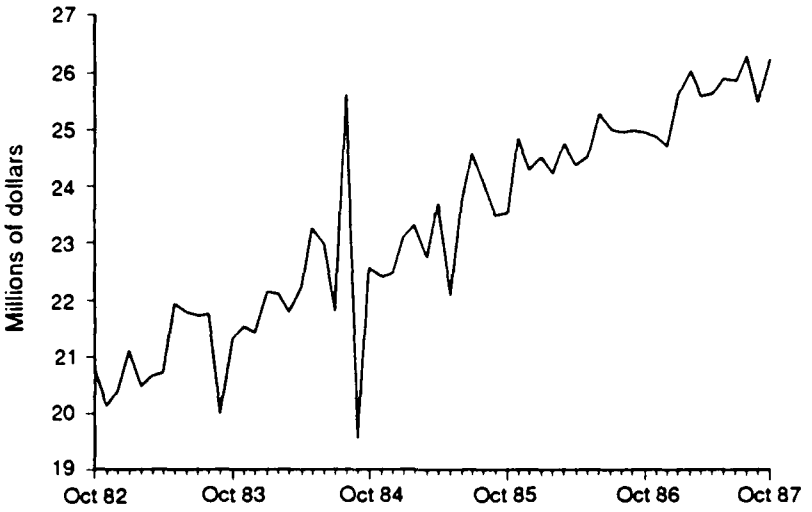


**Figure 5.** Officer BAQ obligations


**Figure 6.** Officer VHA obligations

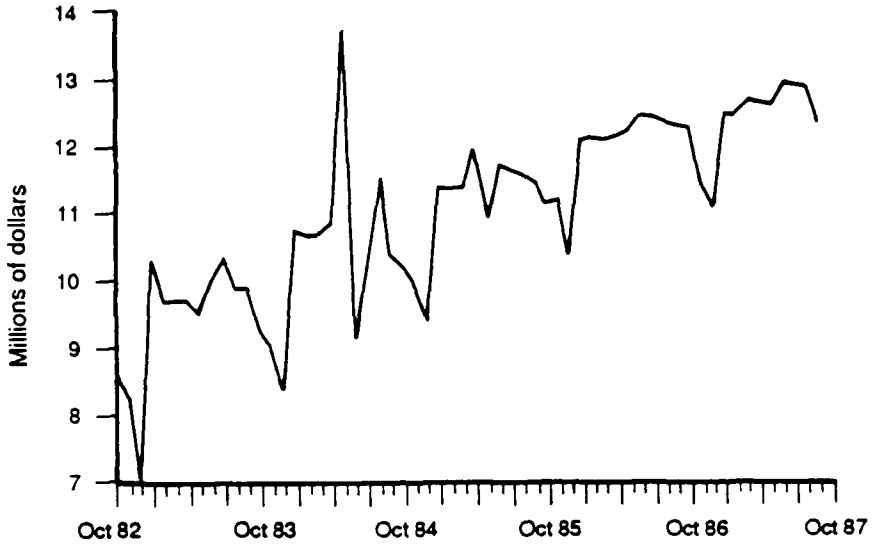


**Figure 7.** Officer FICA obligations

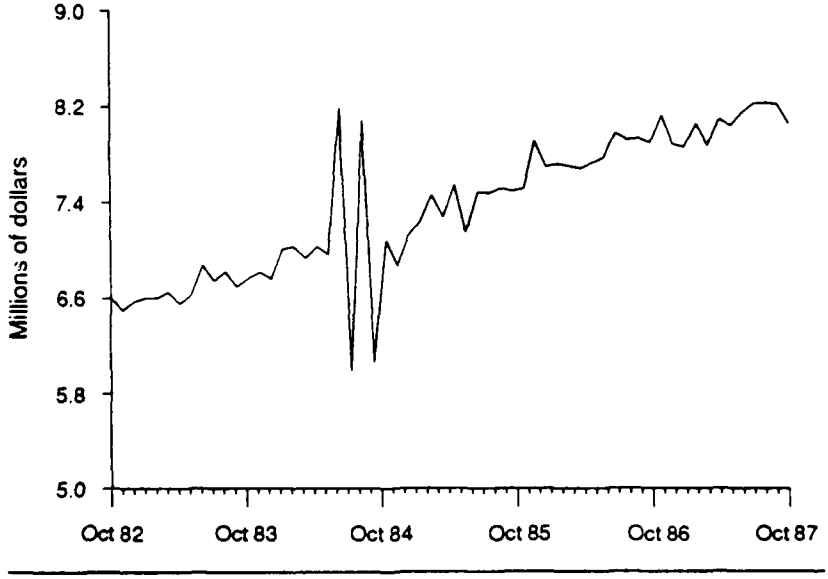


**Figure 8.** Officer BAS obligations

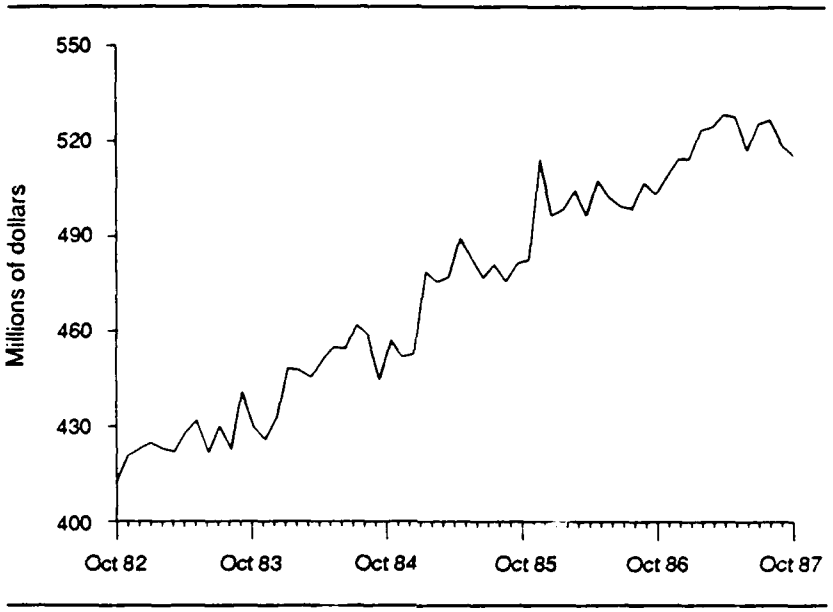


**Figure 9.** Enlisted basic pay obligations

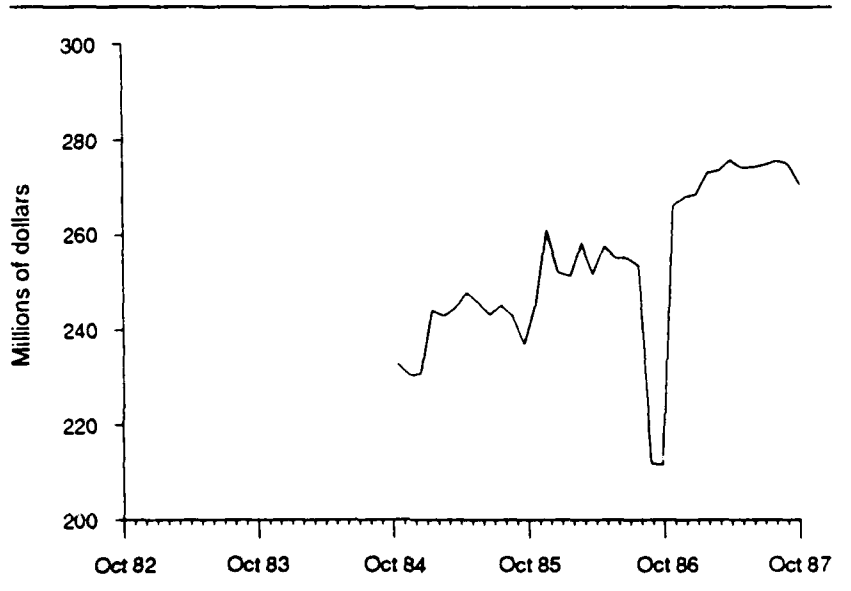


**Figure 10.** Enlisted RPA obligations

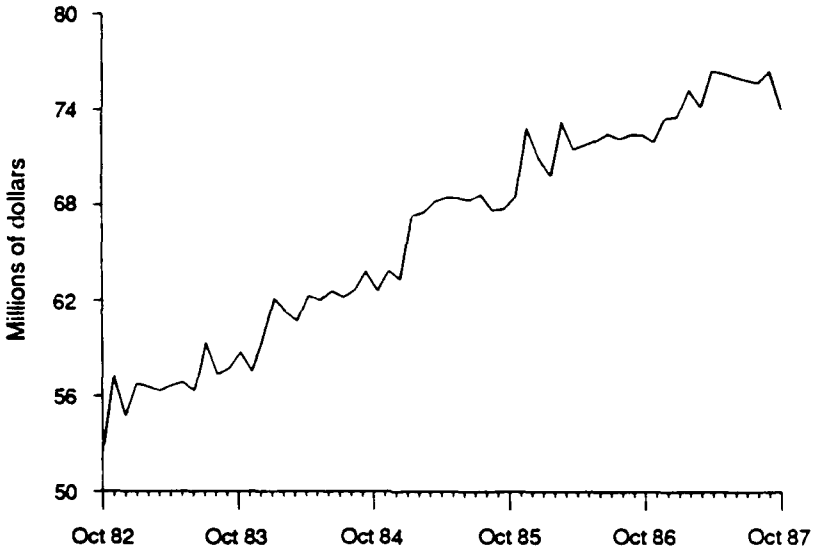


**Figure 11.** Enlisted BAQ obligations

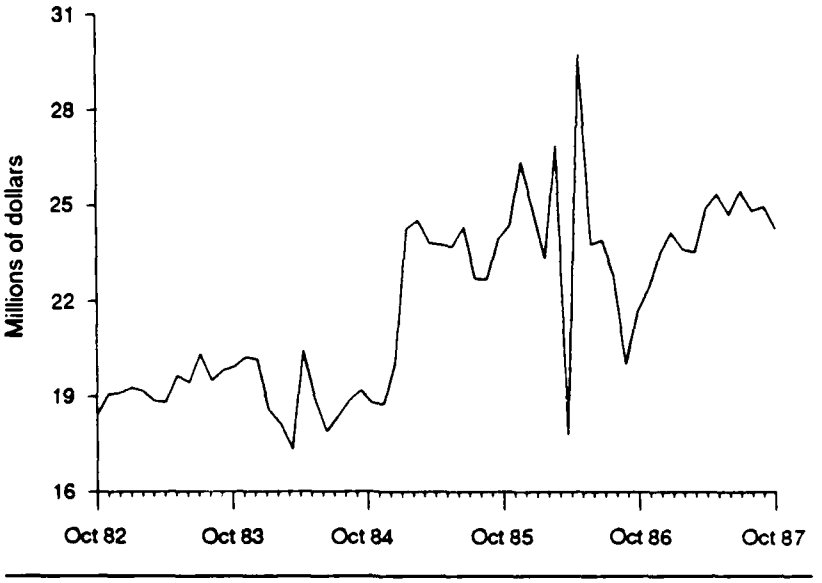


**Figure 12.** Enlisted VHA obligations

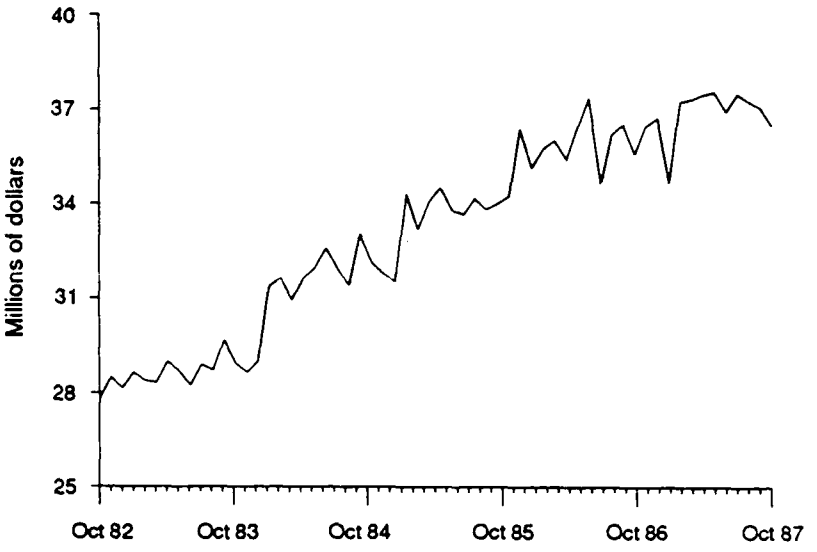


**Figure 13.** Enlisted FICA obligations


**Figure 14.** Enlisted BAS/SIK obligations

More detailed analysis is required in order to explain obligations with an acceptable degree of accuracy,[1] and this follows.

**Table 8.** Correlation of officer strength and obligations

| | Basic pay | RPA | BAQ | VHA | BAS | FICA |
|---|---|---|---|---|---|---|
| Officer strength | .92 | .49 | .89 | .77 | .85 | .80 |
| Basic Pay | | .69 | .95 | .86 | .91 | .81 |
| RPA | | | .65 | .53 | .63 | .49 |
| BAQ | | | | .85 | .94 | .83 |
| VHA | | | | | .84 | .71 |
| BAS | | | | | | .74 |

**Table 9.** Correlation of enlisted strength and obligations

| | Basic pay | RPA | BAQ | VHA | BAS | SIK | FICA |
|---|---|---|---|---|---|---|---|
| Enlisted strength | .84 | .79 | .83 | .59 | .73 | −.02 | .82 |
| Basic pay | | .90 | .99 | .78 | .82 | −.11 | .98 |
| RPA | | | .89 | .77 | .61 | −.13 | .88 |
| BAQ | | | | .78 | .83 | −.10 | .98 |
| VHA | | | | | .51 | −.13 | .75 |
| BAS | | | | | | .42 | .83 |
| SIK | | | | | | | −.05 |

## Chronology of Pay Raises

Pay raises, changes in rates for RPA and FICA, etc., have not been considered thus far in the analysis. When that information is included, much of the variation in obligation levels is explained. Changes in FY 1983 compensation during FY 1983 to FY 1987 are summarized below. Table 10 exhibits basic pay raises that occurred during that time. The same raises occurred in BAS (and SIK) rates.

1. An acceptable level of accuracy is hard to define. From a statistical viewpoint, being able to forecast obligations to within 1 percent seems accurate. However, 1 percent of $17 billion is a large sum, and the Navy needs to manage the MPN account with a tolerance of error considerably smaller than $170 million. The accuracy of forecasting methods and its implications on MPN appropriation management are discussed later in this report.

**Table 10.** Basic pay and subsistence raises

| Date of raise | Pay raise (percent) |
|---|---|
| January 1984 | 4 |
| January 1985 | 4 |
| October 1985 | 3 |
| January 1987 | 3 |

Retired pay accrual is computed as a certain percentage of basic pay. The rates that applied during 1983 to 1987 are shown in table 11.

**Table 11.** Retired pay accrual rates

| Effective dates | RPA rate (percent) |
|---|---|
| Oct 82–Sep 84 | None |
| Oct 84–Jul 86 | 50.7 |
| Aug 86–Sep 86 | 42.0 |
| Oct 86–Sep 87 | 52.2 |

Changes in FICA have followed federal guidelines and are displayed in table 12.

**Table 12.** FICA rates

| Calendar year | FICA rate (percent) | FICA cap (dollars) |
|---|---|---|
| 1982 | 6.7 | 32,400 |
| 1983 | 6.7 | 35,700 |
| 1984 | 7.0 | 37,800 |
| 1985 | 7.05 | 39,600 |
| 1986 | 7.15 | 42,000 |
| 1987 | 7.15 | 43,800 |

BAQ rates vary by pay grade and according to whether the personnel have dependents. With the exception of January 1985, percentage changes in BAQ have been invariant across pay grades and dependent status (see table 13).

**Table 13.** BAQ raises

| Date of raise | BAQ raise (percent) |
|---|---|
| January 1984 | 4 |
| January 1985 | * |
| October 1985 | 3 |
| January 1987 | 3 |

Except for the January 1985 raise, all BAQ increases have been the same as for basic pay. The January 1985 raise for officers varied across pay grades and averaged approximately 2.3 percent. The January 1985 BAQ raise for enlisted personnel was more complex, with different raises occurring across pay grades and according to whether or not the personnel had dependents. The BAQ rate for enlisted personnel without dependents increased, on average, by approximately 8.2 percent, while the rate for enlisted personnel with dependents increased, on average, by approximately 5.7 percent.

Changes in VHA rates are discussed more fully in the next section, which provides case-by-case analyses of the several MPN line items.

## ESTIMATION OF OFFICER STRENGTH-RELATED OBLIGATIONS

### Basic Pay

Basic pay is the largest MPN cost item and should be amenable to accurate estimation, given knowledge of inventories. A model is built that multiplies inventories by pay tables in a canonical manner to obtain estimates of basic pay obligations. Since all personnel are paid according to their pay grade and length of service, it is necessary to have pay-grade-by-length-of-service distributions of officer inventories. CNA obtains extracts of the Officer Master File every six months. These files were processed to produce the required distributions. These distributions were used in conjunction with the FY 1983 pay table, which led to average-pay-by-pay-grade data as displayed in table 14. Showing average pay with regard to a fixed pay table provides insight into the fiscal impact of any changes in force seniority: the variations in table 14 are due solely to fluctuations in force seniority. One may translate the data in table 14 to

the average pay rates actually experienced by inflating the data by the pay raises shown in table 10.

**Table 14.** Officer average monthly basic pay (FY 1983 pay table)

| Month | O-7+ | O-6 | O-5 | O-4 | O-3 | O-2 | O-1 | W-4 | W-3 | W-2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mar 1982 | 4,674[a] | 3,670 | 2,921 | 2,418 | 1,996 | 1,590 | 1,169 | 2,356 | 1,966 | 2,086 |
| Sep 1982 | 4,674 | 3,685 | 2,933 | 2,421 | 2,011 | 1,600 | 1,163 | 2,361 | 1,970 | 2,096 |
| Mar 1983 | 4,674 | 3,684 | 2,925 | 2,416 | 1,993 | 1,590 | 1,167 | 2,348 | 1,964 | 2,088 |
| Sep 1983 | 4,674 | 3,695 | 2,926 | 2,416 | 1,999 | 1,592 | 1,164 | 2,353 | 1,974 | 2,093 |
| Mar 1984 | 4,674 | 3,691 | 2,922 | 2,414 | 1,997 | 1,600 | 1,160 | 2,360 | 1,964 | 2,096 |
| Sep 1984 | 4,674 | 3,704 | 2,934 | 2,418 | 2,006 | 1,600 | 1,169 | 2,354 | 1,970 | 2,116 |
| Mar 1985 | 4,674 | 3,695 | 2,930 | 2,417 | 2,001 | 1,592 | 1,160 | 2,350 | 1,966 | 2,110 |
| Sep 1985 | 4,674 | 3,696 | 2,946 | 2,423 | 2,012 | 1,595 | 1,158 | 2,364 | 1,973 | 2,110 |
| Mar 1986 | 4,674 | 3,687 | 2,945 | 2,427 | 2,008 | 1,588 | 1,153 | 2,363 | 1,972 | 2,102 |
| Sep 1986 | 4,674 | 3,697 | 2,959 | 2,447 | 2,019 | 1,604 | 1,160 | 2,375 | 1,984 | 2,100 |
| Mar 1987 | 4,674 | 3,693 | 2,961 | 2,444 | 2,015 | 1,584 | 1,155 | 2,381 | 1,985 | 2,101 |
| Sep 1987 | 4,674 | 3,691 | 2,972 | 2,460 | 2,025 | 1,578 | 1,161 | 2,380 | 1,984 | 2,113 |

a. Distributions of flag-rank officers by pay grade were not available. Therefore, average pay was estimated to be the average of pay for O-7s and more senior admirals. This inaccuracy has an insignificant effect on the estimation process due to the small number of flag-rank officers.

Table 14 exhibits frequent changes in a pay grade's average pay, with most of the pay grades showing growth (caused by growth in seniority within a pay grade). Taking a weighted average across pay grades of the data in table 14 gives the average basic pay of an officer. This information is displayed in figure 15. (Figure 15 is not really required for the study at hand. However, it is of independent interest and displays the cost of any "aging" of the officer community that may have occurred in recent years.)

Table 14 displays average basic pay, based on an FY 1983 pay table, at fixed points in time—the last days in March and September for 1982 to 1987. The analysis requires data on average pay during a month for each month during FY 1983 to FY 1987. Unfortunately, monthly data were not available. Table 14 was used to estimate the required information in three steps. Initially, the data in table 14 were escalated by the pay raises that occurred during fiscal years 1983 to 1987. Then, the resulting data were interpolated to provide an estimate of average pay at the end of each month. Finally, the average of successive end-of-month estimates was computed as a proxy for average pay during the intervening month. In this fashion, estimates for average officer basic pay, by pay grade, for each month during FY 1983 to FY 1987 were obtained.

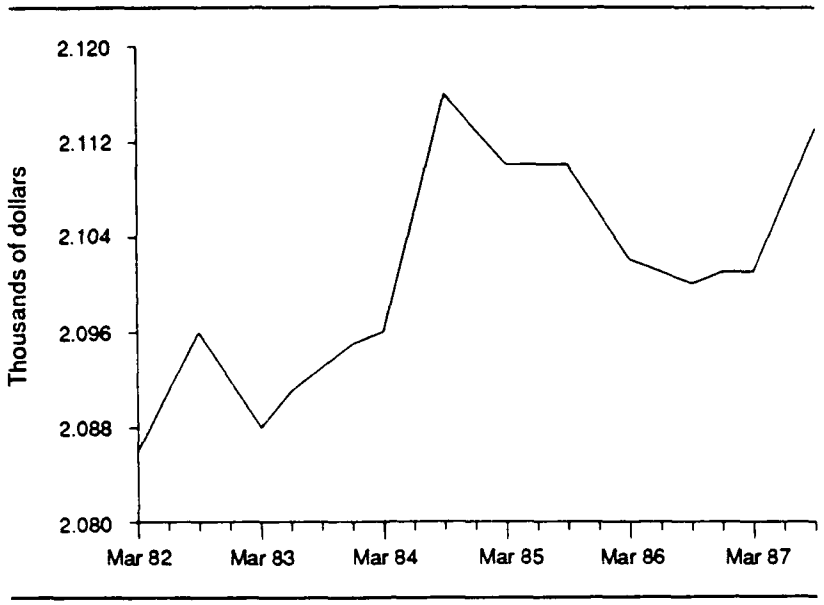


**Figure 15.** Officer average basic pay (based on FY 1983 pay table)

Next, average basic pay data were multiplied by analogous information on average strength to provide an initial estimate of basic pay obligations. Because the strength data were end-strength counts, it was again necessary to take the average of successive observations to provide average monthly strength estimates. After summing across pay grades, the computed estimate of total officer basic pay obligations was compared with obligations as reported by NMPC-7 and displayed in table B-1 of appendix B. The comparison, graphically displayed in figure 16, shows that the estimate is marginally but consistently less than actual obligations. Possible causes of inaccuracy in the estimation process are several: the estimation of average monthly pay and inventories; problems in the data-reporting systems; and the existence of reimbursable monies in the MPN account.

To correct for these errors, an adjustment factor was computed using regression techniques. In detail, actual basic pay obligations were regressed upon the computed basic pay data using ordinary-least-squares estimation. The regression line was constrained to pass through the origin. Table 15 lists pertinent statistics.

That table demonstrates that a factor of 1.017 provides an excellent adjustment to the initial computations in order to provide a more accurate estimate of officer basic pay. The accuracy of the adjusted data can be seen in figures 17 and 18. Figure 17 shows monthly estimation errors, whereas figure 18 displays cumulative fiscal year errors. The monthly errors (root mean square error = $3 million) need to be considered in the context of monthly obligations of approximately $150 million (i.e., errors around 2 percent). Figure 18 shows that the relative size of the errors shrinks in the cumulative fiscal year data, where one is considering annual obligations of approximately $1.8 billion. The accuracy of the estimates is more precisely displayed by consider-

ing confidence intervals around the predictions (see table 16). (Reference [2], pp. 134-135, contains technical details on the prediction of confidence intervals. In theory, the size of the confidence interval varies with the size of the prediction. In practice, given the relative stability of basic pay obligations, the confidence intervals can be considered to be independent of the prediction.)

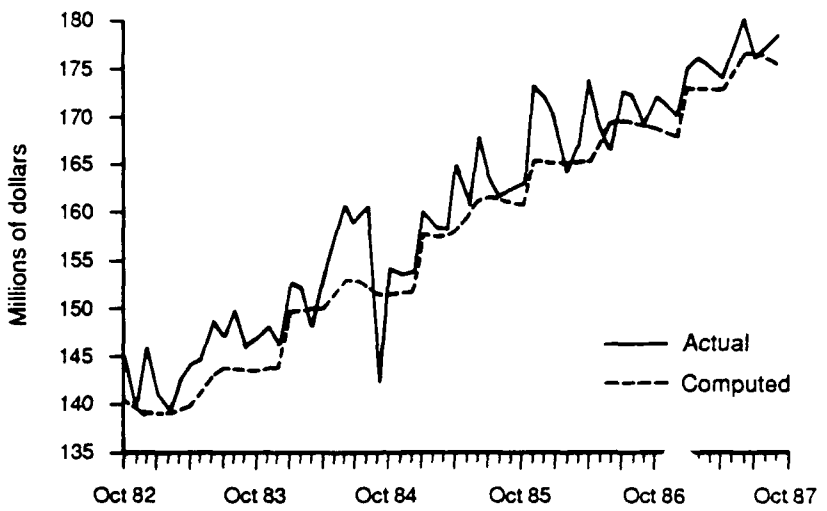


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**Figure 16.** Officer basic pay obligations (actual vs. computed)

**Table 15.** Regression statistics for officer basic pay estimation

| | | |
|---|---|---|
| Regression coefficient | = | 1.017 |
| Standard error of coefficient | = | .002 |
| t-statistic | = | 413.9 |
| R-square | = | .94 |
| Root mean square error | = | $3 million |
| Coefficient of variation | = | 1.88 |
| Degrees of freedom | = | 59 |
| Durbin-Watson statistic | = | 2.08 |

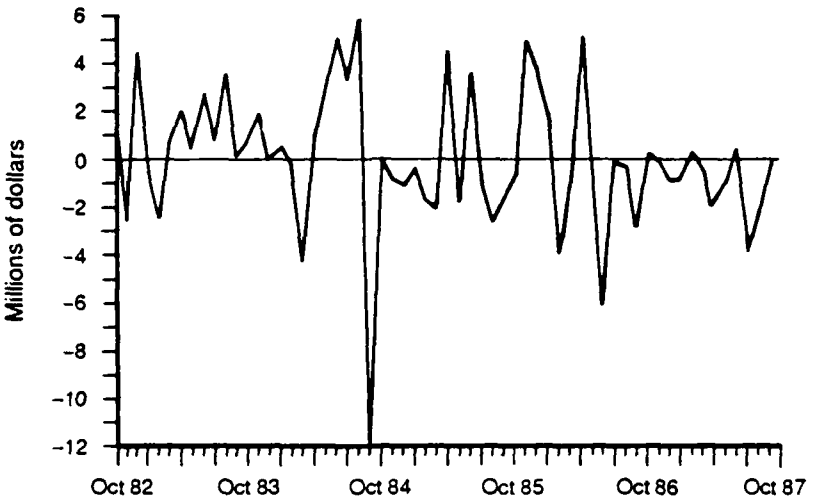


**Figure 17.** Officer basic pay estimation (actual minus predicted)

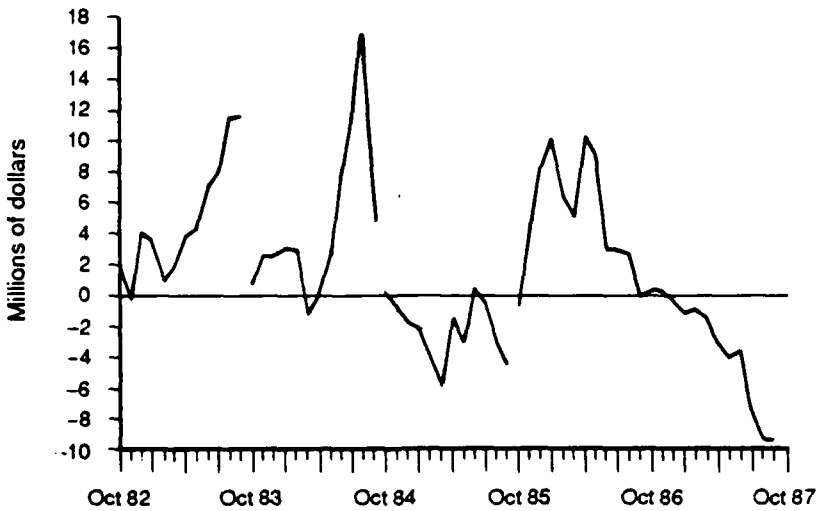


**Figure 18.** Officer basic pay estimation (cumulative fiscal year error)

**Table 16.** *Officer basic pay forecast confidence intervals (in millions of dollars)*

| | Confidence level | |
|---|---|---|
| | 95 percent | 80 percent |
| One-month forecast | 5.9 | 3.9 |
| Three-month forecast | 10.3 | 6.7 |

Table 16 shows the confidence one has in the accuracy of the predictions. For example, one has 95 percent confidence that true officer basic pay obligations will be within $10.3 million of the forecast, based upon three months of strength data. The use of this information should be to warn Navy management when deviations from budgetary plans are more than month-to-month fluctuations and represent a significant divergence from plans. It is understood that these margins of error are larger than the Navy desires and that management of the MPN account to margins of approximately $1 million is an explicit objective. However, the data show that this goal is not readily attainable and that the "noise" in the system is significantly greater than $1 million.

### Retired Pay Accrual

RPA became part of the MPN account in FY 1984. Each month, a specified percentage of basic pay is set aside to fund retirement. This is a pay item that should be amenable to very accurate prediction, given a knowledge of basic pay obligations. Table 8 displays a correlation of .69 between officer basic pay and RPA. However, this computation does not consider the changes in RPA rates that are described in table 11. If one controls for changes in RPA rates, a correlation of .92 between officer basic pay and RPA is obtained. If one multiplies monthly basic pay obligations by the appropriate RPA rates, estimates of RPA obligations are obtained. Figure 19, which displays the accuracy of the estimates (actual obligations less the estimates), reveals that in FY 1985, obligations were consistently above the estimates until the end of the year when there appears to have been a one-time adjustment. In FY 1986 and FY 1987, the estimates are nearly all within $1 million of the estimates. Overall, the errors have a mean value of approximately $0.3 million and a standard deviation of $1.5 million. The estimates are indeed accurate: monthly fluctuations are comparatively minor around an estimate that is, on average, almost exactly correct.

### Basic Allowance for Quarters

BAQ is intended to provide a cash allowance for military personnel not provided with government quarters adequate for themselves and their dependents to enable such personnel to

obtain civilian housing as a substitute. This description is taken from [3], which is an excellent and comprehensive source of information on military compensation. Not every officer receives BAQ, and for those personnel that do receive BAQ, the rates vary with grade and whether or not they have dependents. In addition, comparatively little money is obligated in partial BAQ for personnel in substandard government housing and bachelors in the field.

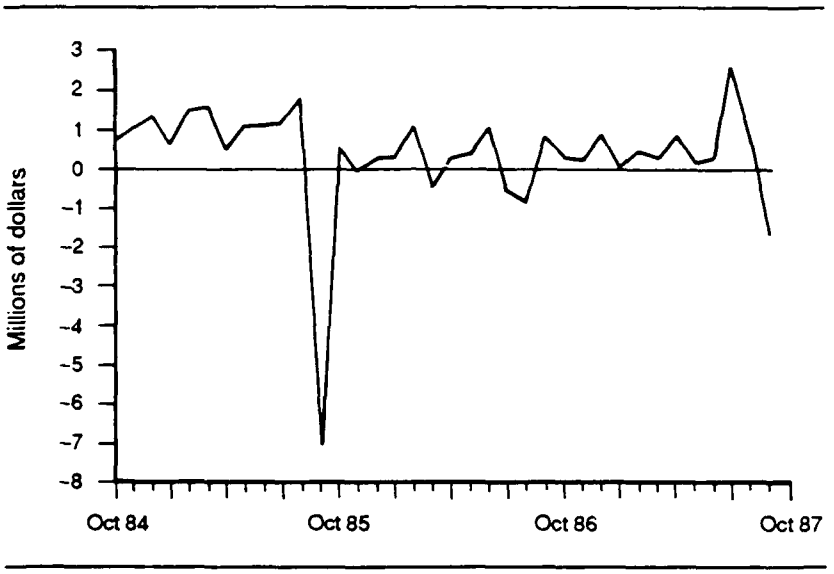


**Figure 19.** Officer RPA estimation error

BAQ obligations were estimated in a canonical fashion. First, data were obtained that describe the percentages of officers receiving BAQ at both the "with dependents" and the "without dependents" rates. The data are displayed in appendix C and are annual observations for FY 1983 to FY 1987. These entitlement distributions were multiplied by the appropriate monthly inventories and pay tables to obtain initial estimates of monthly BAQ obligations. A priori, this process has a number of sources of error. First, partial BAQ payments are not included in the estimation process, which presumably introduces a systematic underestimation of total BAQ payments. (Partial BAQ was not considered in the estimation process due to lack of data, the relatively small size of partial BAQ payments, and the desire for parsimony in the estimation approach.) Second, the use of annual BAQ entitlement distributions carries an implicit assumption that the distributions do not change during a year. This has a "smoothing" effect on the estimations and implies that the estimations will not account for all monthly variations. The estimates of BAQ were compared with actual BAQ obligations, and the differences are displayed in figure 20.

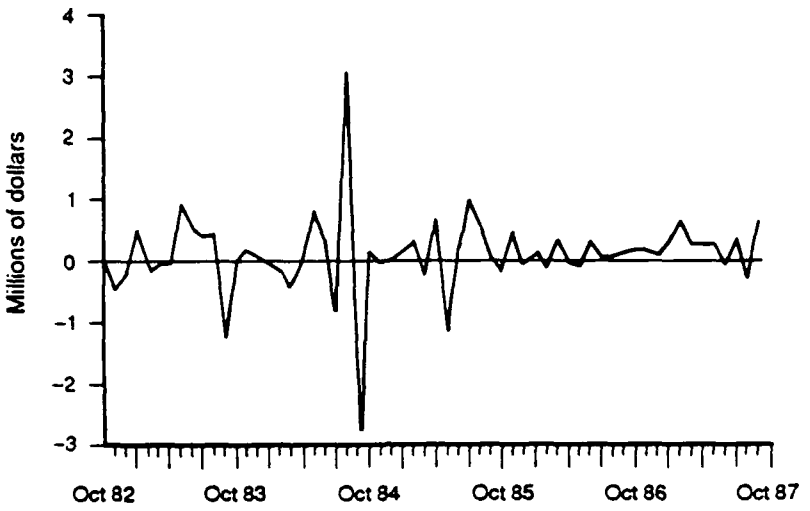


**Figure 20.** Officer BAQ initial estimate (actual minus estimated)

BAQ obligations are approximately $25 million per month, and the figure shows that the BAQ estimates are quite accurate. Apart from a perturbation at the end of FY 1984, estimates are within roughly $1 million of actual obligations, and the majority of estimates are within a few hundred thousand dollars. The estimates are marginally but consistently less than actual obligations, as was expected from the above comments. In order to correct for this underestimation, an adjustment factor was computed. Actual obligations were regressed upon the estimated obligations, constraining the line to pass through the origin. In order to eliminate any biases caused by pay raises, the data were normalized by BAQ rate changes, and all the observations were expressed in terms of FY 1983 BAQ rates. The results of the regression are described in table 17.

**Table 17.** Regression statistics for officer BAQ estimation

| | | |
|---|---|---|
| Regression coefficient | = | 1.004 |
| Standard error of coefficient | = | .004 |
| t-statistic | = | 258.3 |
| R-square | = | .55 |
| Root mean square error | = | $650,000 |
| Coefficient of variation | = | 3.0 |
| Degrees of freedom | = | 59 |
| Durbin-Watson statistic | = | 2.97 |

The regression results are encouraging. The t-statistic and R-square values are highly significant, and the root mean square error is not too large. Measures of the precision of the results are given by the prediction confidence intervals in table 18. (The data in table 18 are expressed in terms of FY 1987 pay rates.) The Durbin-Watson statistic indicates negative serial correlation, caused primarily by the large fluctuation in BAQ obligations at the end of FY 1984.

**Table 18.** Officer BAQ forecast confidence intervals (in millions of dollars)

| | Confidence level | |
|---|---|---|
| | 95 percent | 80 percent |
| One-month forecast | 1.5 | 1.0 |
| Three-month forecast | 2.6 | 1.7 |

Finally, if the original estimates are multiplied by the adjustment factor and compared to actual obligations, errors, as displayed in figure 21, are obtained. The estimates are now centered around actual obligation levels.

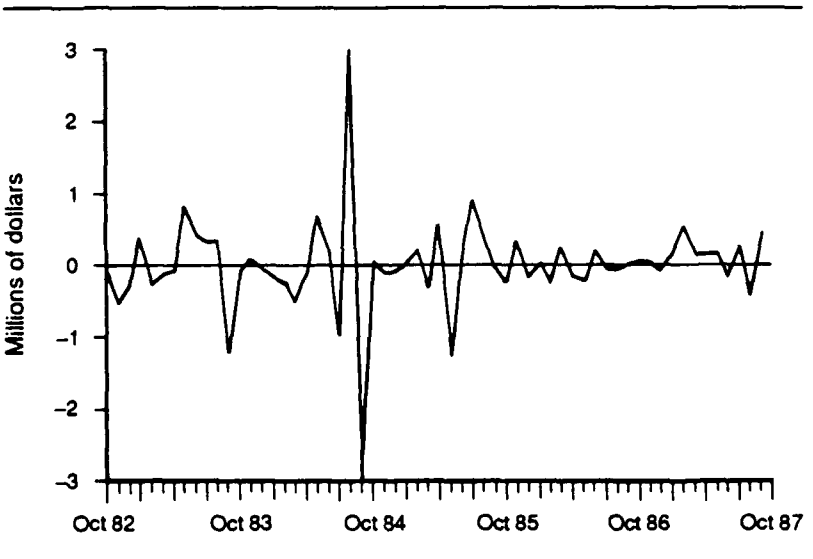


**Figure 21.** Officer BAQ final estimate (actual minus estimated)

## Variable Housing Allowance

VHA is paid as a supplemental allowance for BAQ in high-cost housing areas. Similar to BAQ rates, VHA rates vary by grade and the existence of dependents. However, VHA rates also vary among several hundred housing areas across the United States, including Hawaii and Alaska since 1986. The complexity of VHA militates against obtaining concise methods of forecasting VHA obligations. This is demonstrated below. Initially, some examples of VHA rates are given to show the large variations that occur both between different locations and over time. Table 19 exhibits VHA rates that were set during FY 1983 to FY 1986, for each of four locations (VHA rates were unchanged during FY 1987).

**Table 19.** Officer VHA rates for selected locations (in dollars)

| | O-7+ | O-6 | O-5 | O-4 | O-3 | O-2 | O-1 | W-4 | W-3 | W-2 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | With Dependents | | | | | |
| San Diego, CA | | | | | | | | | | |
| Oct 1982 | 159.08 | 206.02 | 217.88 | 207.97 | 162.60 | 130.25 | 154.07 | 183.08 | 170.67 | 178.20 |
| Jan 1984 | 133.58 | 183.82 | 197.48 | 189.97 | 146.40 | 115.85 | 142.37 | 165.68 | 154.77 | 163.80 |
| Jan 1985 | 247.92 | 278.06 | 264.92 | 256.67 | 206.14 | 167.01 | 174.09 | 251.61 | 236.46 | 231.15 |
| Oct 1985 | 287.15 | 302.00 | 282.85 | 273.72 | 218.77 | 176.53 | 184.02 | 251.51 | 247.25 | 240.52 |
| New Orleans, LA | | | | | | | | | | |
| Oct 1982 | 120.90 | 178.18 | 182.41 | 189.88 | 117.88 | 94.07 | 125.00 | 148.21 | 142.88 | 153.25 |
| Jan 1984 | 95.40 | 155.98 | 162.01 | 171.88 | 101.69 | 79.67 | 113.30 | 130.81 | 126.98 | 138.85 |
| Jan 1985 | 137.87 | 178.25 | 157.18 | 170.49 | 146.58 | 114.96 | 103.59 | 171.00 | 176.42 | 168.51 |
| Oct 1985 | 171.33 | 196.96 | 169.48 | 183.07 | 156.09 | 121.76 | 109.86 | 166.67 | 184.07 | 174.60 |
| | | | | | Without Dependents | | | | | |
| Washington, D.C. | | | | | | | | | | |
| Oct 1982 | 147.46 | 168.94 | 176.78 | 183.60 | 151.52 | 117.34 | 129.63 | 169.62 | 151.29 | 156.74 |
| Jan 1984 | 71.10 | 125.10 | 159.78 | 168.72 | 138.43 | 105.95 | 120.64 | 155.21 | 138.40 | 145.33 |
| Jan 1985 | 167.74 | 197.76 | 210.29 | 207.73 | 218.45 | 165.48 | 162.07 | 233.17 | 219.56 | 218.83 |
| Oct 1985 | 197.90 | 215.78 | 224.81 | 221.77 | 231.49 | 174.78 | 171.24 | 233.98 | 229.69 | 228.21 |
| Norfolk/ Portsmouth, VA | | | | | | | | | | |
| Oct 1982 | 50.85 | 91.32 | 101.02 | 116.16 | 79.06 | 54.38 | 84.93 | 93.83 | 86.91 | 95.17 |
| Jan 1984 | 30.48 | 73.13 | 84.04 | 101.26 | 65.94 | 42.99 | 75.94 | 79.42 | 74.02 | 83.80 |
| Jan 1985 | 120.02 | 146.33 | 148.71 | 143.82 | 129.10 | 109.86 | 112.33 | 177.37 | 152.62 | 157.14 |
| Oct 1985 | 147.67 | 161.67 | 159.99 | 154.52 | 137.44 | 116.24 | 118.89 | 169.19 | 159.27 | 163.27 |

The large variations in rates around the country are to be expected: houses cost more in San Diego than in Norfolk. However, the data contain several anomalies. For example, there are frequent "VHA rate inversions," where personnel in higher pay grades receive smaller amounts of VHA. This is logical, if unexpected, given the manner in which VHA is computed as a supplement to BAQ.

A number of other complexities in the data cause problems from a modeling perspective. First, consider the changes in VHA rates over time. The data indicate a drop in VHA between FY 1983 and FY 1984, a large rise in VHA between FY 1984 and FY 1985, and a modest rise in VHA between FY 1985 and FY 1986. However, beneath these generalities there is a large amount of variation. Table 20 exhibits the percentage changes in VHA rates that occurred for the data found in table 19. Evidently, the changes in VHA rates have varied substantially across pay grades and between locations. These variations make any attempt to obtain a summary method of estimating VHA obligations very difficult. Another way of viewing the instability in VHA rates is to consider the distribution of VHA rates across pay grades. For example, all the rates for a location may be expressed as a fraction of the VHA rate for flag-level officers at that location. Table 21 contains such data. The table shows large variations both between locations and over time, once again indicating that a concise forecast of VHA obligations is not readily attained.

**Table 20.** Percentage changes in officer VHA rates over time

| | O-7+ | O-6 | O-5 | O-4 | O-3 | O-2 | O-1 | W-4 | W-3 | W-2 |
|---|---|---|---|---|---|---|---|---|---|---|
| San Diego, CA | | | | | | | | | | |
| FY 1983-1984 | -16 | -11 | -9 | -9 | -10 | -11 | -8 | -10 | -9 | -8 |
| FY 1984-1985 | 86 | 51 | 34 | 35 | 41 | 44 | 22 | 52 | 53 | 41 |
| FY 1985-1986 | 16 | 9 | 7 | 7 | 6 | 6 | 6 | 0 | 5 | 4 |
| New Orleans, LA | | | | | | | | | | |
| FY 1983-1984 | -21 | -12 | -11 | -9 | -14 | -15 | -9 | -12 | -11 | -9 |
| FY 1984-1985 | 45 | 14 | -? | -1 | 44 | 44 | -9 | 31 | 39 | 21 |
| FY 1985-1986 | 24 | 10 | 8 | 7 | 6 | 6 | 6 | -3 | 4 | 4 |
| Washington, D.C. | | | | | | | | | | |
| FY 1983-1984 | -52 | -26 | -10 | -8 | -9 | -10 | -7 | -8 | -9 | -7 |
| FY 1984-1985 | 136 | 58 | 32 | 23 | 58 | 56 | 34 | 50 | 59 | 51 |
| FY 1985-1986 | 18 | 9 | 7 | 7 | 6 | 6 | 6 | 0 | 5 | 4 |
| Norfolk, VA | | | | | | | | | | |
| FY 1983-1984 | -40 | -20 | -17 | -13 | -17 | -21 | -11 | -15 | -15 | -12 |
| FY 1984-1985 | 294 | 100 | 77 | 42 | 96 | 156 | 48 | 123 | 106 | 88 |
| FY 1985-1986 | 23 | 10 | 8 | 7 | 6 | 6 | 6 | -5 | 4 | 4 |

**Table 21.** Officer VHA rate distributions across pay grades

| | O-7+ | O-6 | O-5 | O-4 | O-3 | O-2 | O-1 | W-4 | W-3 | W-2 |
|---|---|---|---|---|---|---|---|---|---|---|
| San Diego, CA | | | | | | | | | | |
| FY 1983 | 1.00 | 1.30 | 1.37 | 1.31 | 1.02 | 0.82 | 0.97 | 1.15 | 1.07 | 1.12 |
| FY 1984 | 1.00 | 1.38 | 1.48 | 1.42 | 1.10 | 0.87 | 1.07 | 1.24 | 1.16 | 1.23 |
| FY 1985 | 1.00 | 1.12 | 1.07 | 1.04 | 0.83 | 0.67 | 0.70 | 1.01 | 0.95 | 0.93 |
| FY 1986 | 1.00 | 1.05 | 0.99 | 0.95 | 0.76 | 0.61 | 0.64 | 0.88 | 0.86 | 0.84 |
| New Orleans, LA | | | | | | | | | | |
| FY 1983 | 1.00 | 1.47 | 1.51 | 1.57 | 0.98 | 0.78 | 1.03 | 1.23 | 1.18 | 1.27 |
| FY 1984 | 1.00 | 1.64 | 1.70 | 1.80 | 1.07 | 0.84 | 1.19 | 1.37 | 1.33 | 1.46 |
| FY 1985 | 1.00 | 1.29 | 1.14 | 1.24 | 1.06 | 0.83 | 0.75 | 1.24 | 1.28 | 1.22 |
| FY 1986 | 1.00 | 1.15 | 0.99 | 1.07 | 0.91 | 0.71 | 0.64 | 0.97 | 1.07 | 1.02 |
| Washington, D.C. | | | | | | | | | | |
| FY 1983 | 1.00 | 1.15 | 1.20 | 1.25 | 1.03 | 0.80 | 0.88 | 1.15 | 1.03 | 1.06 |
| FY 1984 | 1.00 | 1.76 | 2.25 | 2.37 | 1.95 | 1.49 | 1.70 | 2.18 | 1.95 | 2.04 |
| FY 1985 | 1.00 | 1.18 | 1.25 | 1.24 | 1.30 | 0.99 | 0.97 | 1.39 | 1.31 | 1.30 |
| FY 1986 | 1.00 | 1.09 | 1.14 | 1.12 | 1.17 | 0.88 | 0.87 | 1.18 | 1.16 | 1.15 |
| Norfolk, VA | | | | | | | | | | |
| FY 1983 | 1.00 | 1.80 | 1.99 | 2.28 | 1.55 | 1.07 | 1.67 | 1.85 | 1.71 | 1.87 |
| FY 1984 | 1.00 | 2.40 | 2.76 | 3.32 | 2.16 | 1.41 | 2.49 | 2.61 | 2.43 | 2.75 |
| FY 1985 | 1.00 | 1.22 | 1.24 | 1.20 | 1.08 | 0.92 | 0.94 | 1.48 | 1.27 | 1.31 |
| FY 1986 | 1.00 | 1.09 | 1.08 | 1.05 | 0.93 | 0.79 | 0.81 | 1.15 | 1.08 | 1.11 |

In spite of the above reservations regarding the forecasting of VHA, two models were developed. First, a simple model was estimated in which VHA was regressed upon basic pay. Thus, ordinary-least-squares techniques were used to fit a line of the form,

$$VHA = \alpha + \beta * basic\ pay \ .$$

Basic pay was used instead of total officer strength because variations in pay grade distribution, etc., are reflected in basic pay obligations, and such variations have an effect on VHA obligations. The statistics from this regression are shown in table 22.

The results of the regression are not very useful for prediction purposes. Although the R-square value is rather large and certainly significant, the estimates are so imprecise as to be of little value to Navy management. This imprecision is reflected in the root mean square error and coefficient of variation statistics. A 95-percent confidence interval around a prediction arising

from the above model would be $1.6 million either side of a point estimate. FY 1987 values of VHA obligations were approximately $10 million per month. So, the margin of error in the estimates is large in comparison to the size of VHA obligations.

**Table 22.** Initial regression statistics for officer VHA

| | | |
|---|---|---|
| Constant term ($\alpha$) | = | –$10.6 million |
| Basic pay coefficient ($\beta$) | = | 0.116 |
| Standard error of $\beta$ | = | .009 |
| t-statistic for $\beta$ | = | 13.1 |
| R-square | = | .74 |
| Root mean square error | = | $0.8 million |
| Coefficient of variation | = | 10.0 |
| Degrees of freedom | = | 58 |
| Durbin-Watson statistic | = | 0.67[a] |

a. The Durbin-Watson statistic reflects the large amount of serial correlation that may be found in the estimate errors. The serial correlation is caused by the omission of variables that capture changes in VHA rates.

The model does not consider the effect of compensation changes on either basic pay or VHA; VHA rate changes as an overall percentage change are not easily expressed. However, rate changes did occur at certain points in time, and a regression line can be estimated that includes dummy variables for the four changes in VHA rates that occurred during FY 1983 to FY 1987. In order to make basic pay commensurate, basic pay obligations were normalized by the various increases that occurred during the 1983 to 1987 timeframe (in other words, basic pay obligations were converted to an FY 1983 pay table basis). Thus, the following model was estimated:

$$VHA = \alpha + \beta_1 * Normalized\ Basic\ Pay + \beta_2 * RAISE\text{–}84$$

$$+ \beta_3 * RAISE\text{–}85 + \beta_4 * RAISE\text{–}86 \ ,$$

where *RAISE*-84, *RAISE*-85, and *RAISE*-86, are dummy variables corresponding to rate changes in VHA. The dummy variables take a value of 0 before the rate change takes effect and of 1 thereafter. Table 23 contains the results of the regression.

The data in table 23 show that this model provides a considerably better estimate of VHA obligations. Not only has the R-square statistic improved, but the estimates are more precise. A

95-percent confidence interval is approximately $0.8 million on either side of a point estimate, a considerable improvement on the earlier model. The Durbin-Watson statistic shows that the later model has eliminated nearly all serial correlation in the estimate errors. The coefficients of the dummy variables represent the effects on monthly VHA obligations caused by the various rate changes. Thus, for example, the change in VHA rates in January 1985 caused a monthly decline in obligations of approximately $0.8 million.

**Table 23.** Final regression statistics for officer VHA

| | | |
|---|---|---|
| Constant term ($\alpha$) | = | –$0.93 million |
| Basic pay coefficient ($\beta_1$) | = | 0.053 |
| RAISE-84 coefficient ($\beta_2$) | = | –$0.81 million |
| RAISE-85 coefficient ($\beta_3$) | = | $2.65 million |
| RAISE-86 coefficient ($\beta_4$) | = | $0.66 million |
| Standard error of $\beta_1$ | = | .017 |
| Standard error of $\beta_2$ | = | .17 |
| Standard error of $\beta_3$ | = | .18 |
| Standard error of $\beta_4$ | = | .17 |
| t-statistic for $\beta_1$ | = | 3.1 |
| t-statistic for $\beta_2$ | = | –4.7 |
| t-statistic for $\beta_3$ | = | 14.5 |
| t-statistic for $\beta_4$ | = | 3.9 |
| R-square | = | .93 |
| Root mean square error | = | $0.4 million |
| Coefficient of variation | = | 5.2 |
| Degrees of freedom | = | 55 |
| Durbin-Watson statistic | = | 1.82 |

Although this model shows considerably more accuracy than the first, it is still imprecise. A confidence interval of approximately 8 percent either side of a point estimate (i.e., $0.8 million on either side of $10 million) has a substantial margin of error. In addition, the next time the VHA rates change, the above model will prove inadequate. A further dummy variable will have to be included to account for every rate change, and several months of data will be required after a rate change occurs, before its impact can be estimated. The use of the above VHA estimation approach is thus limited. The underlying problem is the restriction to obtaining a concise estimation technique that is amenable to implementation on a microcomputer—the guideline under which this study proceeded. If one uses the Navy's mainframe computers, accurate estimates of VHA obligations should be readily attainable. The personnel master files would be processed to obtain personnel geographical distribution. This information would be used to compute VHA obligations in conjunction with the VHA tables. This task is straightforward, but rather laborious, and requires a large computer.

**Basic Allowance for Subsistence**

BAS is paid to every officer, and each officer receives the same amount of BAS. Predicting BAS obligations is therefore a simple task, given a knowledge of officer strength.

Between FY 1983 and FY 1987, BAS increased at the same rate as basic pay. Monthly estimates of BAS obligations were obtained by multiplying "average strength" by appropriate BAS rates. Monthly "average strength" was assumed to be the mean of successive monthly end strength counts. The estimates were compared to actual obligations and the results of this comparison are shown in figure 22.

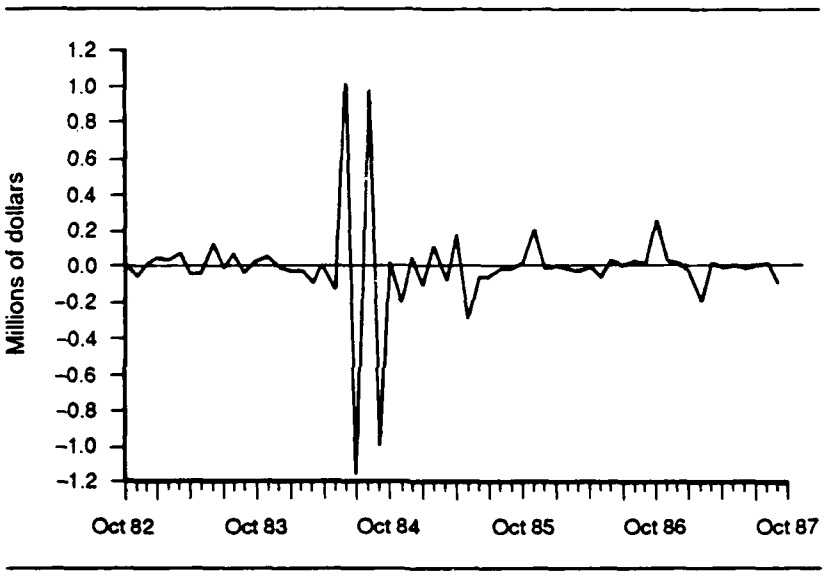


**Figure 22.** Officer BAS estimates (actual minus predicted)

Given that monthly BAS obligations are approximately $8 million, the estimates are consistently accurate. The end of FY 1984 is an exception to this. In fact, the average error in the estimates is approximately $5,000, with a standard deviation of $281,000. This shows that the estimates are not biased either above or below actual obligations, although the standard deviation is uncomfortably large. The situation can be improved by ignoring the data for the last four months in FY 1984. It appears as if a one-time series of accounting problems occurred in 1984, with one month's obligations being under and the next month's being over in order to compensate, etc. After these outliers are removed from the data, an average estimate error of less than $3,000 and a standard deviation of approximately $89,000 can be obtained. This simple estimation method does indeed provide an accurate forecast of officer BAS obligations.

## Social Security Tax

Estimating FICA obligations is somewhat more complicated than was the case for BAS. Figure 7 shows an upward trend in FICA obligations, which is common to other MPN pay categories. However, officer FICA obligations also exhibit a trough in obligations occurring at the end of each calendar year. The cause of these troughs is the pay cap on FICA obligations: above a certain annual pay level no FICA payments are required.

So, although it involves several computations, estimating FICA obligations is not conceptually difficult. One needs to multiply inventories by appropriate FICA and basic pay rates, making sure to place a cap on calendar year obligations from any individual. These computations were carried out, and the resulting estimates were compared with actual FICA obligations. Figure 23 displays the results of the comparison: the estimates are consistently less than actual obligations. This is not unexpected, since FICA is defined as a percentage of basic pay, and the analogous estimates for basic pay were consistently low. As was the case with basic pay, an adjustment factor was estimated. Actual FICA obligations were regressed upon the above estimates, restricting the intercept to the origin. The data were normalized by basic pay and FICA rate changes before the regression in order to make the data commensurate and to remove any bias caused by the rate changes. The results of the regression are shown in table 24.

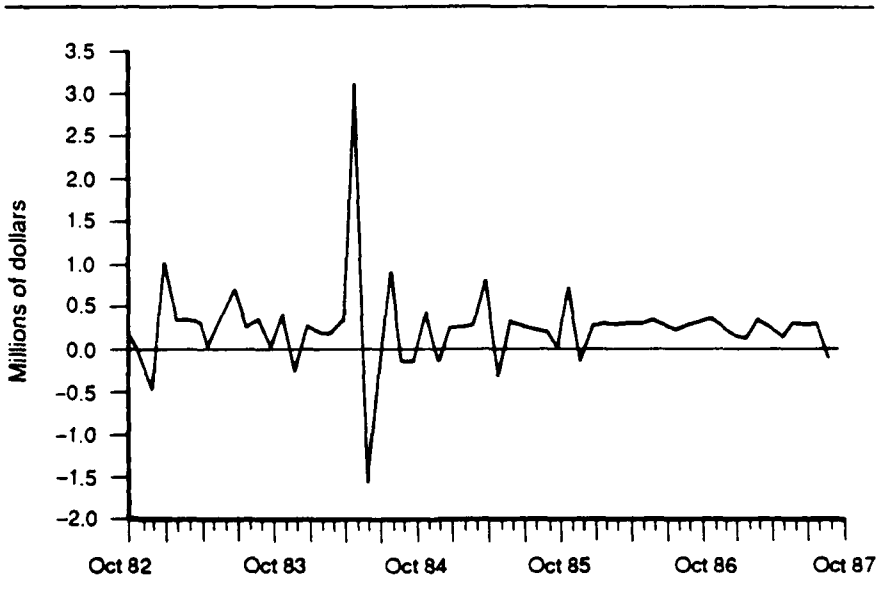


**Figure 23.** Initial officer FICA estimate (actual minus predicted)

**Table 24.** Regression statistics for officer FICA estimation

| | |
|---|---|
| Regression coefficient | = 1.024 |
| Standard error of coefficient | = .007 |
| t-statistic | = 157.5 |
| R-square | = .61 |
| Root mean square error | = $0.5 million |
| Coefficient of variation | = 4.93 |
| Degrees of freedom | = 59 |
| Durbin-Watson statistic | = 2.68 |

The regression results are encouraging. The R-square and t-statistic are highly significant, although the precision of the results is less impressive. Measures of the precision of the results are given by the prediction confidence intervals in table 25. (The data in table 25 are expressed in terms of FY 1987 basic pay and FICA rates.)

**Table 25.** Officer FICA forecast confidence intervals (in millions of dollars)

| | 95 percent | 80 percent |
|---|---|---|
| One-month forecast | 1.0 | 0.6 |
| Three-month forecast | 1.7 | 1.0 |

Monthly FICA obligations are approximately $10 million. So, a 95-percent confidence interval of $1 million on either side of a point estimate is rather large. The final FICA estimates are compared with actual obligations in figure 24.

## ESTIMATION OF ENLISTED STRENGTH-RELATED OBLIGATIONS

### Basic Pay

The analysis of enlisted basic pay is similar to the analogous analysis for officers. Basic pay is estimated in a canonical fashion by applying pay tables to inventory counts. The starting point of the analysis is the computation of average monthly basic pay for each pay grade. Quarterly extracts of the enlisted master file were processed to produce distributions of pay grade by length of service. These distributions were multiplied by the FY 1983 pay table to produce the data displayed in table 26. Table 26 exhibits data outside of the FY 1983 to FY 1987

timeframe, which is the period analyzed in this study. However, the data in table 26 have independent interest, so more extensive information is displayed.

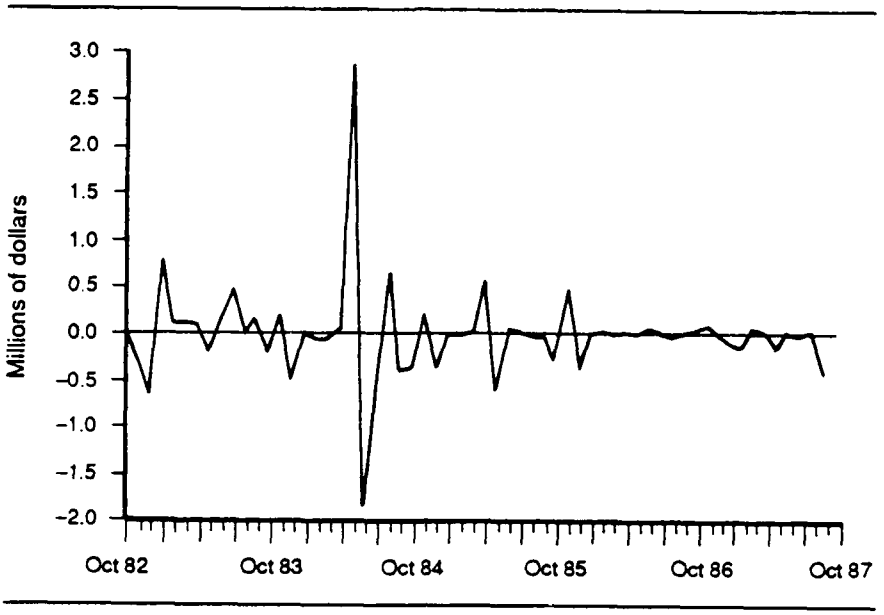


**Figure 24.** Final officer FICA estimate (actual minus predicted)

As was the case for officers, any variations in table 26 are due to changes in the length-of-service distribution within a rating. The data in table 26 are very stable. A more complete picture is provided by taking a weighted average of the above data to obtain data on the average enlisted basic pay of enlisted personnel, as a whole. Figure 25 displays the results of such computations, which show a steady and consistent rise in basic pay obligations during the past several years, caused by increases in the seniority of the Navy's enlisted pay grade distribution. The data in table 26 can be translated to the actual experienced average pay rates by inflating the data by the pay raises shown in table 10.

Table 26 lists average basic pay, based on an FY 1983 pay table, at certain fixed points in time, the last day in every quarter from September 1982 to March 1988. The analysis requires data on average pay during a month for each month during FY 1983 to FY 1987. The table was used to estimate the required information in the same three steps as were used for officer data. Initially, the data in table 26 were escalated by the various pay raises that occurred during FY 1983 to FY 1987. The resulting data were interpolated to provide an estimate of average pay at the end of each month. Finally, the average of successive end-of-month estimates was computed as a proxy for average pay during the intervening month. In this fashion, estimates for average enlisted basic pay, by pay grade, for each month during FY 1983 to FY 1987 were obtained.

**Table 26.** Average monthly enlisted basic pay (FY 1983 pay table)

| | E-9 | E-8 | E-7 | E-6 | E-5 | E-4 | E-3 | E-2 | E-1 |
|---|---|---|---|---|---|---|---|---|---|
| Sep 1982 | 2,036 | 1,684 | 1,412 | 1,163 | 931 | 784 | 690 | 643 | 574 |
| Dec 1982 | 2,040 | 1,688 | 1,414 | 1,165 | 934 | 786 | 690 | 643 | 574 |
| Mar 1983 | 2,044 | 1,692 | 1,418 | 1,165 | 932 | 787 | 692 | 643 | 574 |
| Jun 1983 | 2,045 | 1,694 | 1,421 | 1,168 | 936 | 790 | 693 | 643 | 574 |
| Sep 1983 | 2,046 | 1,692 | 1,413 | 1,165 | 936 | 787 | 692 | 643 | 574 |
| Dec 1983 | 2,049 | 1,695 | 1,413 | 1,162 | 932 | 786 | 690 | 643 | 574 |
| Mar 1984 | 2,050 | 1,694 | 1,412 | 1,161 | 932 | 787 | 689 | 643 | 574 |
| Jun 1984 | 2,050 | 1,694 | 1,410 | 1,157 | 931 | 787 | 689 | 643 | 574 |
| Sep 1984 | 2,056 | 1,697 | 1,410 | 1,162 | 937 | 790 | 691 | 643 | 574 |
| Dec 1984 | 2,056 | 1,695 | 1,411 | 1,158 | 936 | 790 | 692 | 643 | 574 |
| Mar 1985 | 2,053 | 1,690 | 1,411 | 1,156 | 935 | 789 | 692 | 643 | 574 |
| Jun 1985 | 2,048 | 1,687 | 1,408 | 1,156 | 936 | 789 | 692 | 643 | 574 |
| Sep 1985 | 2,050 | 1,690 | 1,406 | 1,156 | 936 | 789 | 691 | 643 | 574 |
| Dec 1985 | 2,048 | 1,687 | 1,406 | 1,155 | 936 | 790 | 691 | 643 | 574 |
| Mar 1986 | 2,048 | 1,685 | 1,406 | 1,155 | 937 | 789 | 691 | 643 | 574 |
| Jun 1986 | 2,045 | 1,682 | 1,406 | 1,156 | 937 | 788 | 690 | 643 | 574 |
| Sep 1986 | 2,049 | 1,685 | 1,404 | 1,157 | 941 | 791 | 691 | 643 | 574 |
| Dec 1986 | 2,048 | 1,685 | 1,405 | 1,157 | 941 | 791 | 690 | 643 | 574 |
| Mar 1987 | 2,049 | 1,685 | 1,405 | 1,159 | 943 | 794 | 691 | 643 | 574 |
| Jun 1987 | 2,046 | 1,681 | 1,408 | 1,158 | 942 | 791 | 690 | 643 | 574 |
| Sep 1987 | 2,051 | 1,684 | 1,405 | 1,160 | 945 | 792 | 691 | 643 | 574 |
| Dec 1987 | 2,054 | 1,684 | 1,407 | 1,160 | 944 | 791 | 689 | 643 | 574 |
| Mar 1988 | 2,059 | 1,688 | 1,409 | 1,164 | 949 | 794 | 691 | 643 | 574 |

The next stage of the analysis involved the computation of an estimate of basic pay obligations. Average basic pay data were multiplied by analogous information on average strength to provide an initial estimate of basic pay obligations. Because the strength data were end-strength counts, it was again necessary to take the average of successive observations to provide average monthly strength estimates. After summing across pay grades, the computed estimate of total enlisted basic pay obligations was compared with obligations as reported by NMPC-7 and displayed in table B-1 of appendix B. The comparison is displayed in figure 26. This figure shows that the estimate is marginally but consistently less than actual obligations, especially in the last couple of years (on average, actual obligations were $1.5 million larger than the estimates). The possible causes of inaccuracy in the estimation process are several: the estimation of average monthly pay and inventories; problems in the data-reporting systems; the existence of reimbursable monies in the MPN account; and the inclusion of the pay of officer candidates in enlisted obligations. The last item will cause a small but consistent underestimate of obligations, because officer candidates are not included in inventory counts obtained from the enlisted master file.

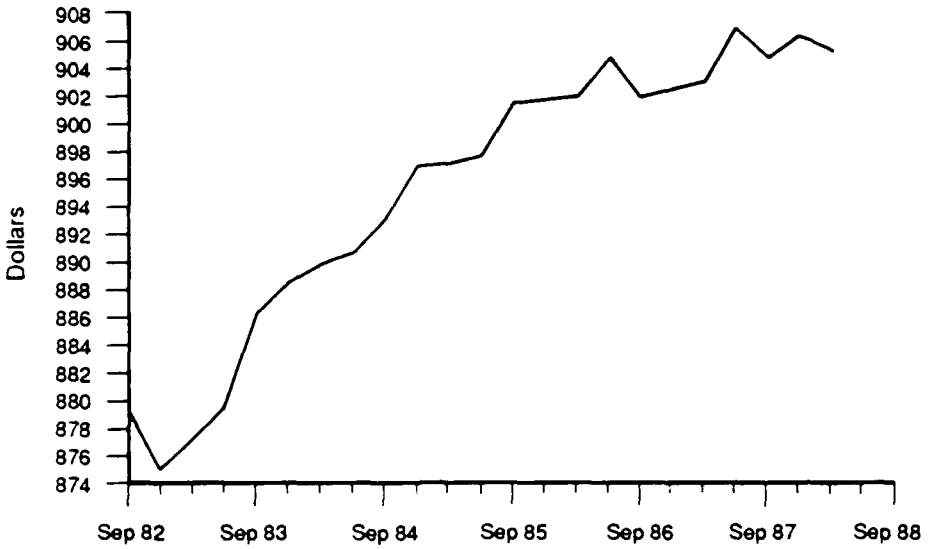


**Figure 25.** Enlisted average monthly basic pay (based on FY 1983 pay table)

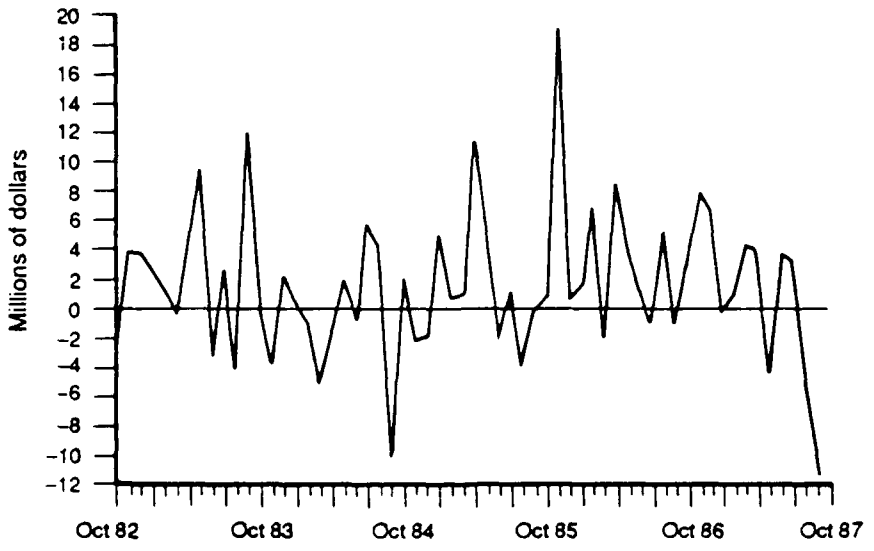


**Figure 26.** Enlisted basic pay obligations (actuals minus initial estimates)

In order to correct for these errors, an adjustment factor was computed using regression techniques. In detail, actual basic pay obligations were regressed upon the computed basic pay data using ordinary-least-squares estimation. The data were normalized by pay raises before the regression in order to make the data commensurate and to remove any biases caused by the pay raises. The regression line was constrained to pass through the origin. Table 27 displays pertinent statistics.

**Table 27.** Regression statistics for enlisted basic pay estimation

| | | |
|---|---|---|
| Regression coefficient | = | 1.003 |
| Standard error of coefficient | = | .001 |
| t-statistic | = | 726.4 |
| R-square | = | .86 |
| Root mean square error | = | $4.7 million |
| Coefficient of variation | = | 1.07 |
| Degrees of freedom | = | 59 |
| Durbin-Watson statistic | = | 2.02 |

Table 27 demonstrates that a factor of 1.003 provides an excellent adjustment to the initial computations in order to provide a more accurate estimate of enlisted basic pay. Given the closeness of the adjustment to unity, the significance of the difference between the regression coefficient and unity could be questionable. However, the smallness of the standard error of the estimate indicates that the adjustment factor is indeed significantly different from unity. The accuracy of the adjusted data can be seen in figures 27 and 28. Figure 27 shows monthly estimation errors, and figure 28 displays cumulative fiscal year errors. The monthly errors (root mean square error = $4.7 million) need to be considered in the context of monthly obligations of approximately $450 million (based upon FY 1983 pay rates). Figure 28 shows that the size of the errors shrinks relative to the cumulative fiscal year data, where annual obligations of approximately $5.5 billion are considered. The accuracy of the estimates is more precisely displayed by considering confidence intervals around the predictions. Table 28 exhibits appropriate information.

**Retired Pay Accrual**

RPA became part of the MPN account in FY 1984. Each month, a specified percentage of basic pay is set aside to fund retirement. This pay item should be amenable to very accurate prediction, given a knowledge of basic pay obligations, and table 8 displays a correlation of .91 between enlisted basic pay and RPA. However the computation does not consider the changes in RPA rates that are described in table 11. If changes in RPA rates are controlled for, a correlation of .99 between officer basic pay and RPA is obtained. If monthly basic pay obligations are

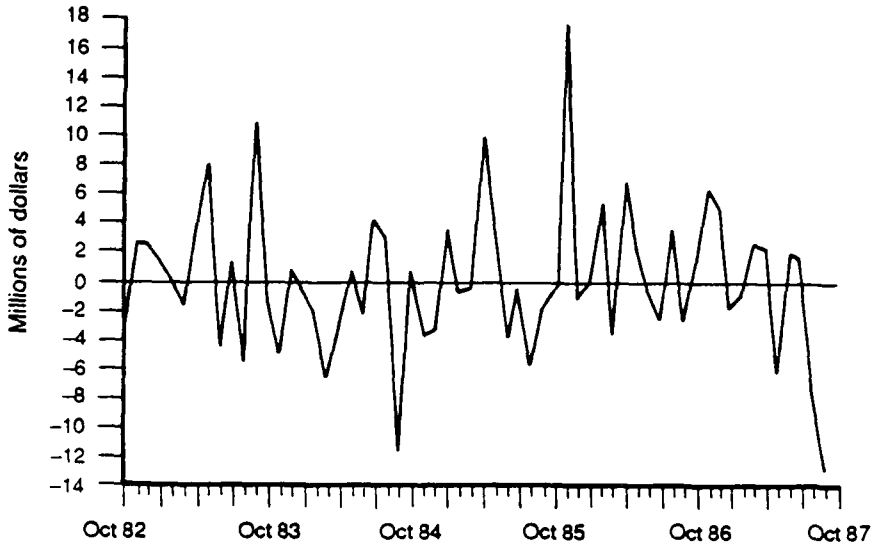


**Figure 27.** Enlisted basic pay obligations (actuals minus final estimates)

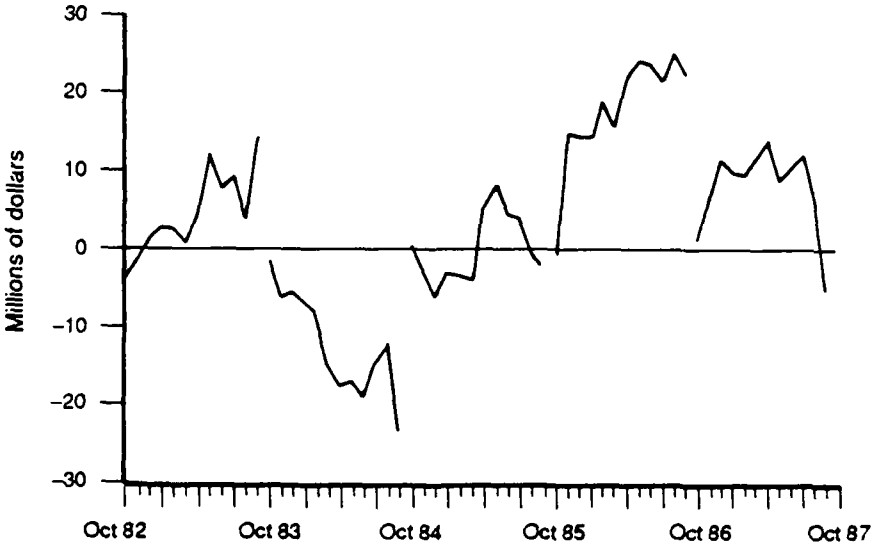


**Figure 28.** Enlisted basic pay estimation (cumulative fiscal year error)

multiplied by the appropriate RPA rates, estimates of RPA obligations are obtained. Figure 29 displays the accuracy of the estimates (actual obligations less the estimates). Given the magnitude of RPA obligations (approximately $250 million per month), the estimates are very accurate with a few fluctuations. Overall, the errors have a mean value of approximately $0.2 million and a standard deviation of $2.0 million. As was the case for officer RPA, the estimates are indeed accurate: the monthly fluctuations are comparatively minor around an estimate that is, on average, almost exactly correct.

**Table 28.** Enlisted basic pay forecast confidence intervals (in millions of dollars)

| | Confidence level | |
|---|---|---|
| | 95 percent | 80 percent |
| One-month forecast | 9.3 | 6.1 |
| Three-month forecast | 16.1 | 10.6 |

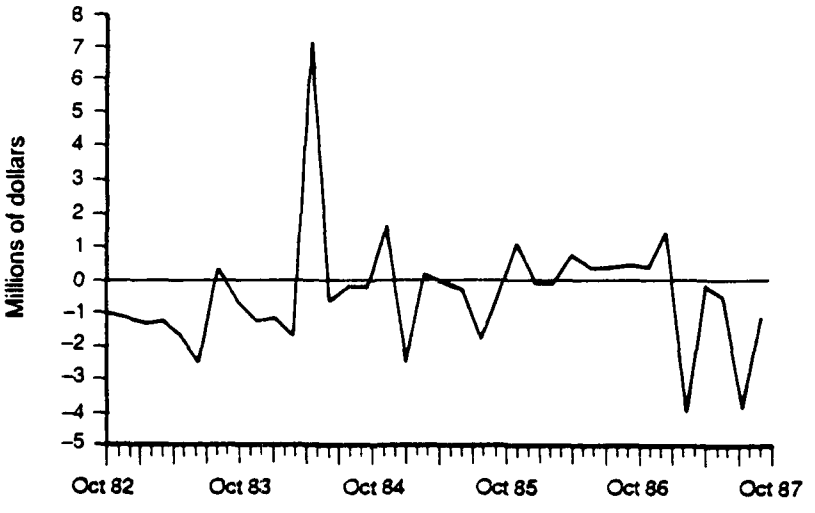


**Figure 29.** Enlisted RPA estimation error

## Basic Allowance for Quarters

As was pointed out, BAQ is intended to provide a cash allowance to military personnel not provided with government quarters adequate for themselves and their dependents to enable such

personnel to obtain civilian housing as a substitute. Thus, not all enlisted personnel receive BAQ, and for those that do, the rates vary with grade and whether or not the personnel have dependents. In addition, comparatively little money is obligated in partial BAQ for personnel in substandard government housing and bachelors in the field.

Enlisted BAQ obligations were estimated in the same manner as were officer obligations. First, data were obtained that describe the percentages of enlisted personnel receiving BAQ at both the "with dependents" and the "without dependents" rates. The data are displayed in appendix C and are annual observations for FY 1983 to FY 1987. These entitlement distributions were multiplied by the appropriate monthly inventories and pay tables to obtain initial estimates of monthly BAQ obligations. This process has numerous sources of errors similar to those applying to officer BAQ as described previously. The estimates of BAQ were compared with actual BAQ obligations, and the differences are displayed in figure 30.

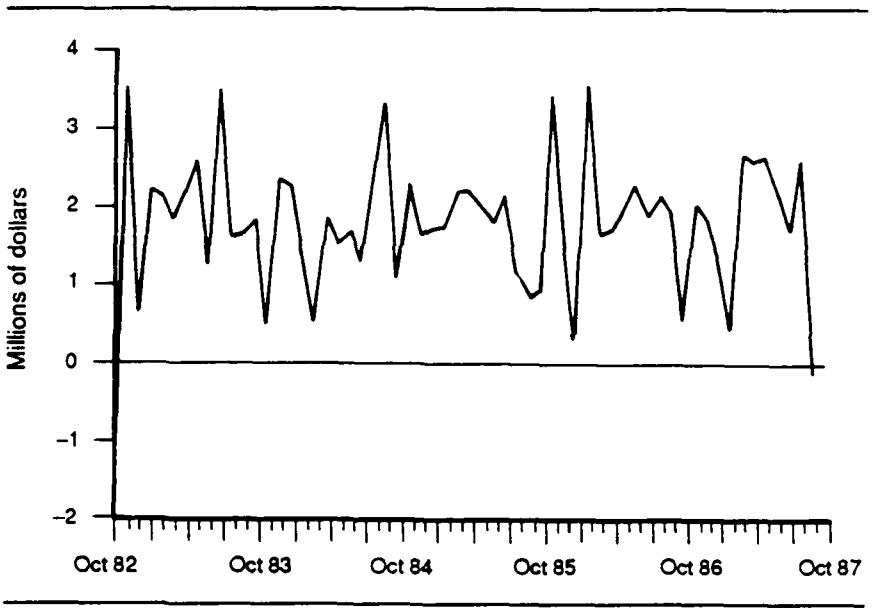


**Figure 30.** Enlisted BAQ obligations (actuals minus initial estimates)

The figure shows that the estimates are consistently less than actual obligations, as was to be expected from the above comments. In order to correct for this underestimation, an adjustment factor was computed. Actual obligations were regressed upon the estimated obligations, constraining the line to pass through the origin. In order to eliminate any biases caused by pay raises, the data were normalized by BAQ rate changes. Thus, all the observations were expressed in terms of FY 1983 BAQ rates. The results of the regression are described in table 29.

**Table 29.** Regression statistics for enlisted BAQ estimation

| | | |
|---|---|---|
| Regression coefficient | = | 1.028 |
| Standard error of coefficient | = | .002 |
| t-statistic | = | 552.2 |
| R-square | = | .92 |
| Root mean square error | = | $858,000 |
| Coefficient of variation | = | 1.4 |
| Degrees of freedom | = | 59 |
| Durbin-Watson statistic | = | 2.27 |

The regression results are encouraging. The t-statistic and R-square values are significant, and the root mean square error is relatively small (at 1983 BAQ rates, average monthly BAQ obligations were more than $61 million during 1983 to 1987). Measures of the precision of the results are given by the prediction confidence intervals in table 30. (The data in table 30 are expressed in terms of FY 1987 BAQ rates.)

**Table 30.** Enlisted BAQ forecast confidence intervals (in millions of dollars)

| | Confidence level | |
|---|---|---|
| | 95 percent | 80 percent |
| One-month forecast | 1.7 | 1.1 |
| Three-month forecast | 2.9 | 1.9 |

Finally, if the original estimates are multiplied by the adjustment factor and compared to actual obligations, one obtains errors as displayed in figure 31. The estimates are now centered around actual obligation levels.

### Variable Housing Allowance

As was the case with officers, the complexity of enlisted VHA militates against an ability to obtain concise methods of forecasting VHA obligations. This is demonstrated below. The examples of VHA rates given show the large variations in VHA rates that occur both between different locations and over time. Table 31 exhibits VHA rates that were set during FY 1983 to FY 1986, for each of four locations (VHA rates were unchanged during FY 1987).

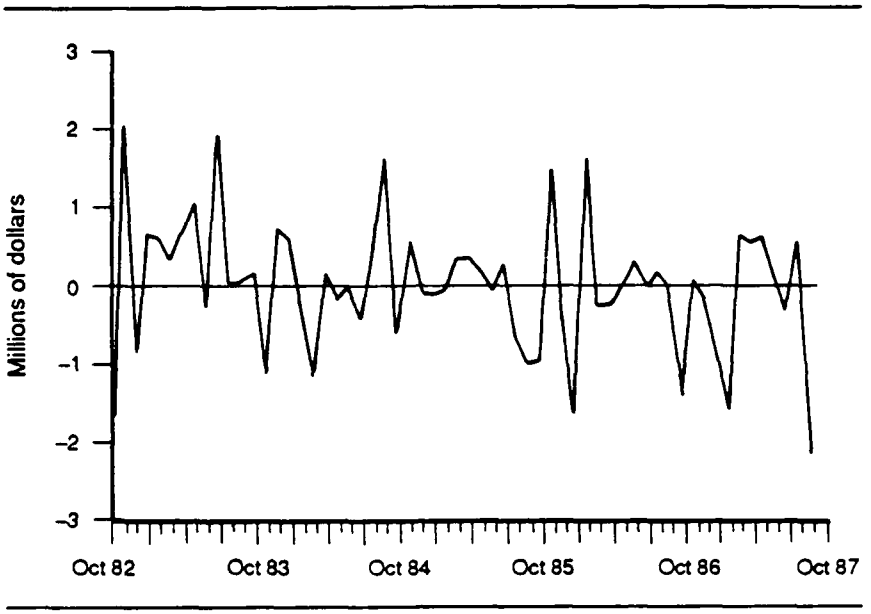


**Figure 31.** Enlisted BAQ obligations (actuals minus final estimates)

The data follow the same patterns as officer VHA data: large variations in rates as one moves around the country and a variety of anomalies in the data, such as rate inversions with respect to pay grade.

From a modeling perspective, the complexities in the data are familiar. First, consider the changes in VHA rates over time. The data indicate a drop in VHA between FY 1983 and FY 1984, a large rise in VHA between FY 1984 and FY 1985, and a modest rise in VHA between FY 1985 and FY 1986. However, beneath these generalities there is a large amount of variation. Table 32 exhibits the percentage changes in VHA rates that occurred for the data found in table 31. Evidently, the changes in VHA rates have varied substantially across pay grades and between locations. These variations make any attempt to obtain a summary method of estimating VHA obligations very difficult. Another way of viewing the instability in VHA rates is to consider the distribution of VHA rates across pay grades. For example, all the rates for a location may be expressed as a fraction of the VHA rate for E-9s at that location. Table 33 contains such data. The table shows large variations both between locations and over time, once again indicating that a concise forecast of VHA obligations is not readily attained.

In spite of the above reservations regarding the forecasting of VHA, two models were developed. The analysis followed the approach used for officer VHA. First, a simple model was estimated in which VHA was regressed upon basic pay. Thus, ordinary-least-squares techniques were used to fit a line of the form

$$VHA = \alpha + \beta * Basic\ Pay \quad .$$

Basic pay was used instead of total enlisted strength because variations in pay grade distribution, etc., are reflected in basic pay obligations, and such variations have an effect on VHA obligations. The statistics from this regression are given in table 34.

**Table 31.** Enlisted VHA rates for selected locations (in dollars)

| | E-9 | E-8 | E-7 | E-6 | E-5 | E-4 | E-3 | E-2 | E-1 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | With Dependents | | | | | |
| San Diego, CA | | | | | | | | | |
| Oct 1982 | 168.70 | 173.46 | 174.58 | 148.62 | 130.99 | 115.06 | 130.30 | 108.94 | 100.39 |
| Jan 1984 | 153.40 | 159.36 | 161.38 | 136.62 | 119.89 | 105.16 | 121.90 | 100.54 | 91.99 |
| Jan 1985 | 201.87 | 202.51 | 194.75 | 173.72 | 161.93 | 139.68 | 132.63 | 123.79 | 136.74 |
| Oct 1985 | 214.88 | 214.97 | 205.36 | 182.97 | 159.43 | 145.50 | 135.90 | 133.82 | 141.72 |
| New Orleans, LA | | | | | | | | | |
| Oct 1982 | 172.53 | 177.00 | 161.41 | 142.55 | 122.63 | 105.26 | 123.89 | 104.66 | 93.98 |
| Jan 1984 | 157.23 | 162.90 | 148.21 | 130.55 | 111.53 | 95.36 | 115.49 | 96.26 | 85.58 |
| Jan 1985 | 139.09 | 159.32 | 147.81 | 130.56 | 119.98 | 109.99 | 103.39 | 93.71 | 106.74 |
| Oct 1985 | 148.33 | 169.93 | 155.97 | 137.55 | 125.83 | 114.26 | 105.12 | 102.15 | 110.14 |
| | | | | Without Dependents | | | | | |
| Washington, D.C. | | | | | | | | | |
| Oct 1982 | 155.27 | 160.70 | 136.70 | 120.34 | 102.63 | 88.78 | 102.90 | 76.64 | 66.26 |
| Jan 1984 | 144.36 | 150.64 | 128.05 | 112.73 | 95.24 | 82.10 | 97.26 | 71.53 | 61.42 |
| Jan 1985 | 169.79 | 161.73 | 148.62 | 134.06 | 129.42 | 114.84 | 112.85 | 94.46 | 92.07 |
| Oct 1985 | 180.55 | 171.44 | 156.72 | 141.13 | 135.80 | 119.87 | 116.03 | 101.64 | 95.57 |
| Norfolk/Portsmouth, VA | | | | | | | | | |
| Oct 1982 | 79.00 | 85.37 | 74.76 | 65.99 | 54.11 | 44.39 | 60.27 | 40.27 | 33.13 |
| Jan 1984 | 68.11 | 75.34 | 66.15 | 58.35 | 46.70 | 37.73 | 54.57 | 35.16 | 28.30 |
| Jan 1985 | 121.77 | 116.58 | 99.07 | 86.57 | 82.49 | 73.59 | 69.44 | 55.28 | 57.56 |
| Oct 1985 | 129.99 | 123.93 | 104.57 | 91.18 | 86.45 | 76.44 | 70.37 | 60.39 | 59.29 |

**Table 32. Percentage changes in enlisted VHA rates over time**

| | E-9 | E-8 | E-7 | E-6 | E-5 | E-4 | E-3 | E-2 | E-1 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | With Dependents | | | | | |
| San Diego, CA | | | | | | | | | |
| San Diego, CA | | | | | | | | | |
| FY 1983-1984 | -9 | -8 | -8 | -8 | -8 | -9 | -6 | -8 | -8 |
| FY 1984-1985 | 32 | 27 | 21 | 27 | 35 | 33 | 9 | 23 | 49 |
| FY 1985-1986 | 6 | 6 | 5 | 5 | -2 | 4 | 2 | 8 | 4 |
| New Orleans, LA | | | | | | | | | |
| FY 1983-1984 | -9 | -8 | -8 | -8 | -9 | -9 | -7 | -8 | -9 |
| FY 1984-1985 | -12 | -2 | 0 | 0 | 8 | 15 | -10 | -3 | 25 |
| FY 1985-1986 | 7 | 7 | 6 | 5 | 5 | 4 | 2 | 9 | 3 |
| | | | | Without Dependents | | | | | |
| Washington, D.C. | | | | | | | | | |
| FY 1983-1984 | -7 | -6 | -6 | -6 | -7 | -8 | -5 | -7 | 7 |
| FY 1984-1985 | 18 | 7 | 16 | 19 | 36 | 40 | 16 | 32 | 50 |
| FY 1985-1986 | 6 | 6 | 5 | 5 | 5 | 4 | 3 | 8 | 4 |
| Norfolk/Portsmouth, VA | | | | | | | | | |
| FY 1983-1984 | -14 | -12 | -12 | -12 | -14 | -15 | -9 | -13 | -15 |
| FY 1984-1985 | 79 | 55 | 50 | 48 | 77 | 95 | 27 | 57 | 103 |
| FY 1985-1986 | 7 | 6 | 6 | 5 | 5 | 4 | 1 | 9 | 3 |

The results of the regression are not very useful for prediction purposes. Although the R-square value is significant, the estimates are so imprecise as to be of little value to Navy management. This imprecision is reflected in the root mean square error and coefficient of variation statistics. A 95-percent confidence interval around a prediction arising from the above model would be $3.8 million either side of a point estimate. FY 1987 values of VHA obligations were approximately $25 million per month. So, the margin of error in the estimates is large compared to the size of VHA obligations.

The above model does not consider the impact of compensation changes, either for basic pay or VHA. However, rate changes did occur at certain points in time, and a regression line can be estimated that includes dummy variables for the four changes in VHA rates that occurred during FY 1983 to FY 1987. In order to make basic pay commensurate, basic pay obligations were normalized by the various increases that occurred during the 1983 to 1987 timeframe (in

**Table 33.** Enlisted VHA rate distributions across pay grades

| | E-9 | E-8 | E-7 | E-6 | E-5 | E-4 | E-3 | E-2 | E-1 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | With Dependents | | | | | |
| San Diego, CA | | | | | | | | | |
| Oct 1982 | 1.00 | 1.03 | 1.03 | 0.88 | 0.78 | 0.68 | 0.77 | 0.65 | 0.60 |
| Jan 1984 | 1.00 | 1.04 | 1.05 | 0.89 | 0.78 | 0.69 | 0.79 | 0.66 | 0.60 |
| Jan 1985 | 1.00 | 1.00 | 0.96 | 0.86 | 0.80 | 0.69 | 0.66 | 0.61 | 0.68 |
| Oct 1985 | 1.00 | 1.00 | 0.96 | 0.85 | 0.74 | 0.68 | 0.63 | 0.62 | 0.66 |
| New Orleans, LA | | | | | | | | | |
| Oct 1982 | 1.00 | 1.03 | 0.94 | 0.83 | 0.71 | 0.61 | 0.72 | 0.61 | 0.54 |
| Jan 1984 | 1.00 | 1.04 | 0.94 | 0.83 | 0.71 | 0.61 | 0.73 | 0.61 | 0.54 |
| Jan 1985 | 1.00 | 1.15 | 1.06 | 0.94 | 0.86 | 0.79 | 0.74 | 0.67 | 0.77 |
| Oct 1985 | 1.00 | 1.15 | 1.05 | 0.93 | 0.85 | 0.77 | 0.71 | 0.69 | 0.74 |
| | | | | Without Dependents | | | | | |
| Washington, D.C. | | | | | | | | | |
| Oct 1982 | 1.00 | 1.03 | 0.88 | 0.78 | 0.66 | 0.57 | 0.66 | 0.49 | 0.43 |
| Jan 1984 | 1.00 | 1.04 | 0.89 | 0.78 | 0.66 | 0.57 | 0.67 | 0.50 | 0.43 |
| Jan 1985 | 1.00 | 0.95 | 0.88 | 0.79 | 0.76 | 0.68 | 0.66 | 0.56 | 0.54 |
| Oct 1985 | 1.00 | 0.95 | 0.87 | 0.78 | 0.75 | 0.66 | 0.64 | 0.56 | 0.53 |
| Norfolk/Portsmouth, VA | | | | | | | | | |
| Oct 1982 | 1.00 | 1.08 | 0.95 | 0.84 | 0.68 | 0.56 | 0.76 | 0.51 | 0.42 |
| Jan 1984 | 1.00 | 1.11 | 0.97 | 0.86 | 0.69 | 0.55 | 0.80 | 0.52 | 0.42 |
| Jan 1985 | 1.00 | 0.96 | 0.81 | 0.71 | 0.68 | 0.60 | 0.57 | 0.45 | 0.47 |
| Oct 1985 | 1.00 | 0.95 | 0.80 | 0.70 | 0.67 | 0.59 | 0.54 | 0.46 | 0.46 |

**Table 34.** Initial regression statistics for enlisted VHA

| | | |
|---|---|---|
| Constant term ($\alpha$) | = | –$9.0 million |
| Basic pay coefficient ($\beta$) | = | 0.066 |
| Standard error of $\beta$ | = | .007 |
| t-statistic for $\beta$ | = | 9.5 |
| R-square | = | .60 |
| Root mean square error | = | $1.9 million |
| Coefficient of variation | = | 8.7 |
| Degrees of freedom | = | 58 |
| Durbin-Watson statistic | = | 1.63 |

other words, basic pay obligations were converted to an FY 1983 pay table basis). Thus, the following model was estimated:

$$VHA = \alpha + \beta_1 * Normalized\ Basic\ Pay + \beta_2 * RAISE\text{-}84$$

$$+ \beta_3 * RAISE\text{-}85 + \beta_4 * RAISE\text{-}86 \ ,$$

where *RAISE*-84, *RAISE*-85, and *RAISE*-86 are dummy variables corresponding to rate changes in VHA. The dummy variables take a value of 0 before the rate change takes effect and of 1 thereafter. Table 35 contains the results of the regression.

**Table 35.** Final regression statistics for enlisted VHA

| | | |
|---|---|---|
| Constant term ($\alpha$) | = | –$1.55 million |
| Basic pay coefficient ($\beta_1$) | = | 0.0826 |
| RAISE-84 coefficient ($\beta_2$) | = | –$1.45 million |
| RAISE-85 coefficient ($\beta_3$) | = | $4.61 million |
| RAISE-86 coefficient ($\beta_4$) | = | –$.59 million |
| Standard error of $\beta_1$ | = | .017 |
| Standard error of $\beta_2$ | = | .72 |
| Standard error of $\beta_3$ | = | .78 |
| Standard error of $\beta_4$ | = | .73 |
| t-statistic for $\beta_1$ | = | 2.1 |
| t-statistic for $\beta_2$ | = | –2.0 |
| t-statistic for $\beta_3$ | = | 5.9 |
| t-statistic for $\beta_4$ | = | –0.8 |
| R-square | = | .72 |
| Root mean square error | = | $1.62 million |
| Coefficient of variation | = | 7.3 |
| Degrees of freedom | = | 55 |
| Durbin-Watson statistic | = | 2.33 |

The data in table 35 show that this model does not provide a considerably better estimate of VHA obligations. Precision and explanatory power are marginally improved as can be seen by considering the regression residuals for both methods of predicting enlisted VHA obligations. Figure 32 displays these estimation errors and indicates that the latter estimate provides a better model for the 1983 to 1985 timeframe. However, neither model explains the large fluctuations during FY 1986. If one disregards the variations during 1986, then the model appears to be reasonably accurate.

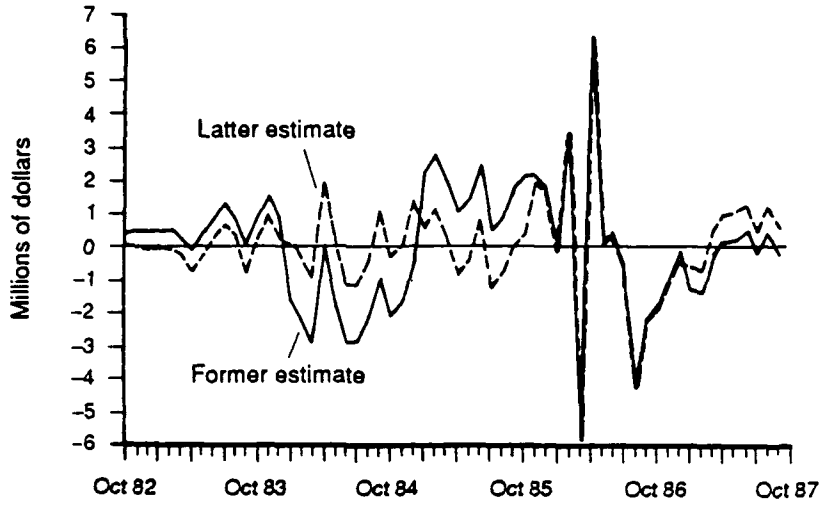


**Figure 32.** *Enlisted VHA obligations (actuals minus estimates)*

As is the case for officer VHA, however, the next time VHA rates change, the above model will prove inadequate. A further dummy variable will have to be included to account for every rate change, and several months of data will be required after a rate change occurs, before its impact can be estimated. Use of the above VHA estimation approach is thus limited. Considering VHA tables in conjunction with geographical distribution data obtained from personnel files is again appropriate.

### Subsistence of Enlisted Personnel

Obligations for the subsistence of enlisted personnel take one of two forms, basic allowance for subsistence (BAS) or subsistence in kind (SIK). Enlisted personnel receive BAS if any of three conditions pertains: rations in kind are not available; permission to "mess" separately has been granted; or personnel are assigned to duty under emergency conditions where no government messing facilities are available. SIK represents the cost of the food provided to personnel in government messing facilities.

No intuitive relationship links a growth in end strength or a pay raise with the level of SIK obligations. SIK obligations reflect variations in the price of food and the number of personnel dining at government messing facilities. The lack of correlation between SIK and enlisted strength (shown in table 9) is thus not surprising. In fact, the average level of SIK obligations did not noticeably change between 1983 and 1987 (see figure 14). Therefore, no further analysis in this area was undertaken.

Enlisted BAS is more difficult to estimate than is officer BAS. Not all enlisted personnel receive BAS, and the rate varies among its recipients according to the aforementioned conditions.

However, during FY 1983 to FY 1987, the various BAS rates have remained the same relative size and have increased at the same rate as basic pay. Moreover, approximately 75 percent of BAS obligations derive from one category—personnel authorized to mess separately. It is thus reasonable to attempt to estimate BAS obligations as being a fixed amount of money per enlisted member. To accomplish this, BAS obligations were regressed on average monthly strength, with the regression line being constrained to pass through the origin (BAS obligations were normalized by pay raises that occurred during the 1983 to 1987 timeframe in a manner analogous to previous estimates). The results of the regression are displayed in table 36.

**Table 36.** Regression statistics for enlisted BAS estimation

| | | |
|---|---|---|
| Regression coefficient | = | 72.9 |
| Standard error of coefficient | = | .5 |
| t-statistic | = | 143.0 |
| R-square | = | .24 |
| Root mean square error | = | $1.95 million |
| Coefficient of variation | = | 5.4 |
| Degrees of freedom | = | 59 |
| Durbin-Watson statistic | = | 1.59 |

The regression results are not encouraging. The R-square value shows that the model does not explain a majority of the variation. In addition, the root mean square error implies a 95-percent confidence interval of approximately $3.9 million around a point estimate. That margin of error is substantial in terms of 1983 BAS rates, where average obligations were approximately $35 million per month. The regression coefficient infers that, on average, an enlisted member received $72.9 per month in BAS. Another way of observing the model's accuracy is through the individual estimate errors, as displayed in figure 33. (The data in the figure have been converted to actual obligations, by inflating the regression residuals by pertinent BAS rate changes.) Unfortunately, figure 33 shows not only that the errors in the estimation process are sizable, but that the estimates have been getting progressively less accurate.

### Social Security Tax

Estimating enlisted FICA obligations is less complex than the corresponding analysis for officers. The pay cap on FICA obligations has no impact on enlisted personnel. Thus enlisted FICA obligations can be estimated as a percentage of enlisted basic pay obligations. The percentage would be the prevailing FICA rate. If one carries out the computations and compares estimated and actual obligations, then one obtains the data displayed in figure 34. One observes that the estimate appears to be unbiased (the estimate errors have a mean value of approximately $25,000). In addition, the size of the estimate errors is comparatively small, given that current

monthly enlisted FICA obligations are approximately $37 million (the estimate errors have a standard deviation of approximately $0.5 million). Accurate estimates of enlisted FICA obligations are thus readily obtained from corresponding information regarding basic pay.

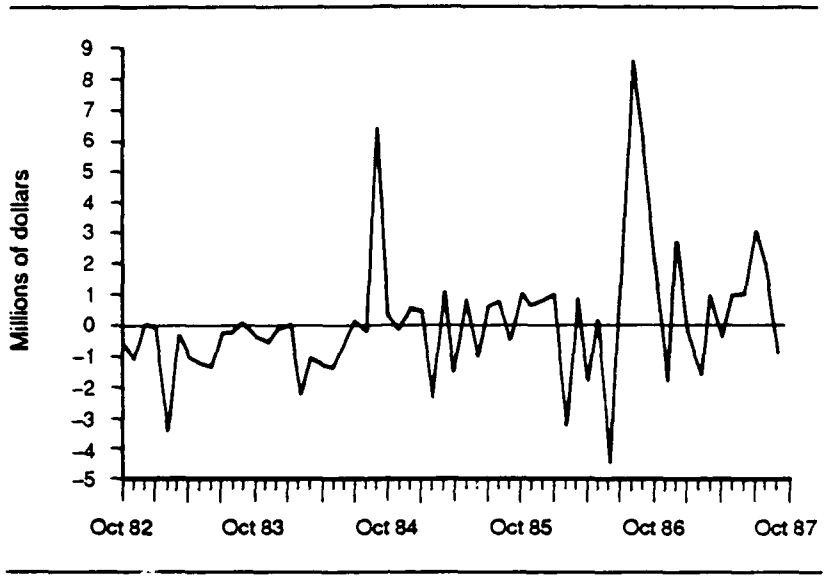


**Figure 33.** Enlisted BAS obligations (actuals minus estimates)

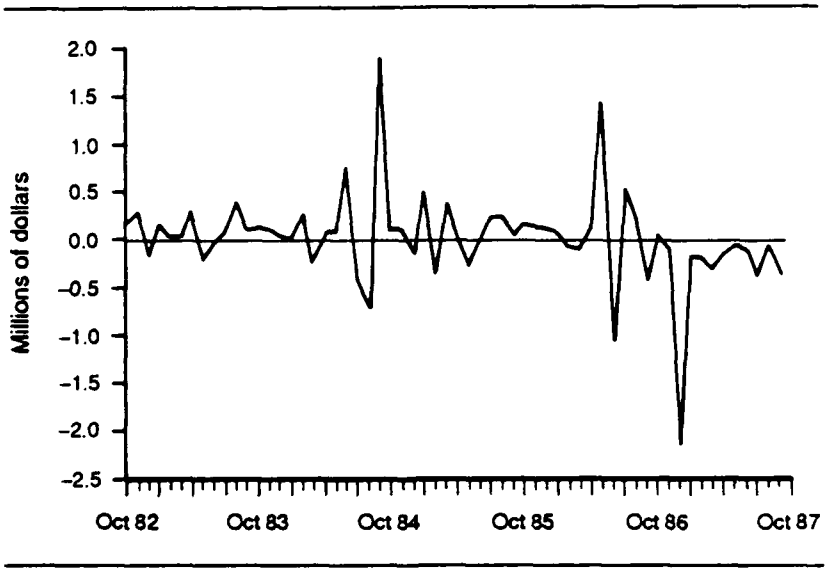


**Figure 34.** Enlisted FICA obligations (actuals minus estimates)

## NON-STRENGTH-RELATED OBLIGATIONS

The above analysis of strength-related obligations has considered a large majority of the entire MPN account. The remaining "non-strength-related" obligations account for approximately 10 percent of the MPN appropriation. These obligations, by definition, are not amenable to the estimation techniques that were applied to "strength-related" obligations. All of the previous analysis was based on the presumption that a knowledge of inventory or basic pay obligations would suffice for the prediction of various MPN line items. If a pay category is not correlated with personnel strength, then one would expect this analytic approach to fail.

The analysis of non-strength-related obligations begins with a tabulation of its components and their FY 987 obligations (see table 37).

**Table 37.** FY 1987 monthly non-strength-related obligations (in millions of dollars)

| Pay category | Obligations |
|---|---|
| Non-strength-related officer pay and allowances | |
| Incentive pay | 95 |
| Special pay | 117 |
| Other[a] | 76 |
| Non-strength-related enlisted pay and allowances | |
| Incentive pay | 93 |
| Special pay | 259 |
| Special duty assignment pay | 51 |
| Enlistment bonus | 12 |
| Reenlistment bonus | 233 |
| Other[b] | 361 |
| Cadets/midshipmen pay and allowances | 36 |
| Permanent change of station costs | 517 |
| Other[c] | 45 |
| Total | 1,895 |

a. Includes overseas station allowance, uniform allowance, family separation allowance, and separation payments.
b. Includes overseas station allowance, clothing allowance, family separation allowance, and separation payments.
c. Includes apprehension of deserters costs, death gratuities, unemployment compensation, survivor's benefits, and education benefits.

Although non-strength-related obligations aggregate to a sizable portion of the MPN account, many of its component parts are rather small, even insignificant from a perspective of the overall status of MPN obligations. For example, enlistment bonuses amount to approximately $12 million a year. A 5-percent variation in enlistment bonus obligations has little effect on MPN expenditures as a whole.

## Correlation of Cost Categories

The correlation of non-strength-related obligations with inventory size and/or basic pay was investigated. Table 38 contains a number of appropriate correlation coefficients. Not all possible correlations were computed because the large number of different coefficients might obscure the underlying observation that inventory size appears to have little or no relation to the subject pay categories. As with all previous computations, the data were monthly observations for FY 1983 to FY 1987.

**Table 38.** Correlation of non-strength-related obligations with strength and basic pay

| | Basic pay | Strength |
|---|---|---|
| Officer | | |
| Incentive pay | −.09 | −.07 |
| Special pay | .12 | .26 |
| Enlisted | | |
| Special pay | .77 | .81 |
| SRB | .15 | .15 |
| Clothing allowance | .37 | .47 |
| Officer and enlisted | | |
| PCS | .02 | .01 |

The above pay items were chosen because each is a comparatively large part of non-strength-related obligations (FY 1987 enlisted clothing allowance obligations were approximately $136 million). Enlisted special pay is the only item that exhibits large correlation with inventory size. This correlation is probably spurious for several reasons. Sea pay comprises roughly 80 percent of enlisted special pay, so the observed correlation is better described as a correlation between sea pay and inventory size. During the 1983 to 1987 timeframe, sea pay, basic pay, and end strength all grew. However, the growth in sea pay obligations was only partially caused by growth in end strength. The rise in sea pay obligations may be attributed to increases in the number of Navy ships, increases in sea pay tables (unrelated to basic pay raises), and increases in sea manning. Only the increases in sea manning could be explained by increases

in inventory. These coincidental alignments will probably not continue. Consequently, it would be inadvisable to attempt to predict sea pay obligations, whence special pay obligations, from a knowledge of end strength.

Two large contributors to non-strength-related obligations—permanent change of station (PCS) and selective reenlistment bonuses (SRB) costs—are now analyzed in order to ascertain whether they can be accurately estimated. As will be seen, neither SRB nor PCS costs are amenable to concise estimation. Instead, the detailed analysis that is carried out in the pertinent offices within OP-01 and NMPC is essential for even an aggregate understanding of obligations in this area. The same conclusion holds for other non-strength-related pay items.

### Permanent Change of Stations Costs

PCS moves are categorized into six types: accession, training, operational, rotational, separation, and organized unit. Some PCS moves result in costs to the Navy, others do not. The relative impact of these move categories on obligations can be seen in table 39.

**Table 39.** Permanent change of station obligations, by fiscal year
(in millions of dollars)

| | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| Officer moves | | | | | |
| Accession | 18.4 | 14.3 | 14.6 | 14.9 | 13.8 |
| Training | 22.3 | 24.1 | 22.4 | 27.6 | 27.4 |
| Operational | 33.3 | 34.6 | 35.4 | 38.8 | 35.2 |
| Rotational | 44.5 | 56.0 | 50.8 | 51.7 | 49.3 |
| Separation | 14.9 | 17.4 | 13.0 | 14.4 | 14.8 |
| Organized unit | 3.3 | 2.8 | 3.9 | 5.0 | 2.2 |
| Enlisted moves | | | | | |
| Accession | 55.8 | 53.1 | 56.7 | 59.1 | 55.7 |
| Training | 27.1 | 28.8 | 33.2 | 40.8 | 35.9 |
| Operational | 80.7 | 87.1 | 103.6 | 102.0 | 83.3 |
| Rotational | 121.7 | 142.7 | 148.2 | 139.4 | 128.1 |
| Separation | 51.1 | 46.9 | 50.9 | 57.7 | 59.7 |
| Organized unit | 16.5 | 12.1 | 16.0 | 16.7 | 14.6 |
| Cadets/midshipmen | | | | | |
| Accession | 0.4 | 0.3 | 0.3 | 0.3 | 0.2 |
| Total | 490.0 | 520.2 | 549.0 | 568.4 | 520.2 |

Table 39 shows that costs of the various PCS move categories do not change dramatically from one year to the next. However, beneath this gross level of accuracy, the data show no clear patterns. Obligations in some move categories rise, while others fall, from one year to the next. Moreover, patterns of change do not persist for all five years. All in all, the above data do not suggest that a knowledge of past obligations will lead to an accurate estimate of future obligations.

One may further investigate PCS costs by looking at the frequency and average costs of the various move categories. The possibilities for consideration are numerous. They all provide the same answer: PCS obligations vary too much to permit a concise and accurate forecasting model. The analysis therefore focuses on two move categories: enlisted rotational and officer operational. Analogous results may be readily attained for other move types. Figures 35 through 40 provide a variety of statistics. Figures 35 through 37 show obligations, move frequencies, and average move costs for enlisted operational moves. Similar information for officer operational moves is displayed in figures 38 through 40. The data are monthly observations for FY 1983 to FY 1987. The data for enlisted rotational moves show large monthly fluctuations in obligations. These fluctuations have been caused by variations in move frequencies, with the average cost of an enlisted rotational move staying fairly constant. The situation for officer operational moves is more complex, with large fluctations occurring in both move frequencies and move costs. It is possible to partially capture the variation in all the move categories by considering the average cost and its standard deviation for each year, based upon monthly observations. The data are shown in tables 40 and 41.

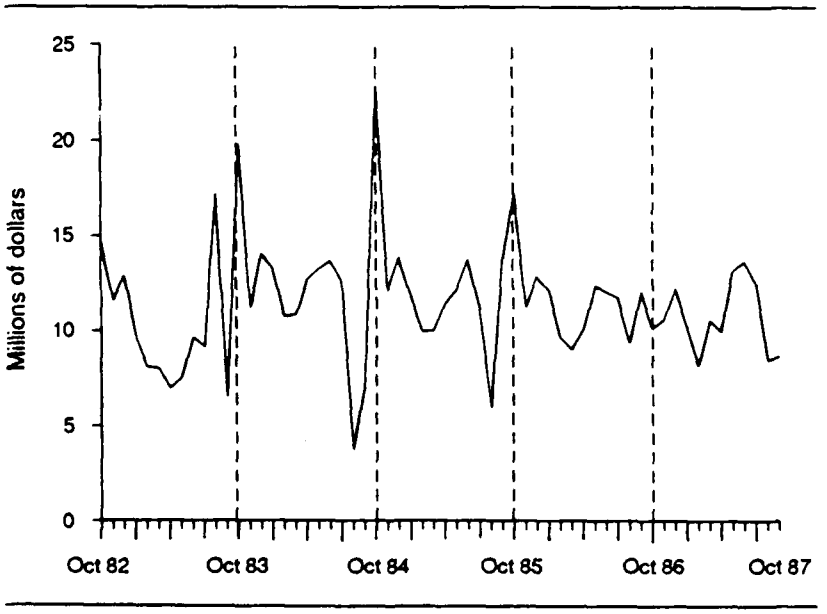


**Figure 35.** Enlisted rotational move obligations

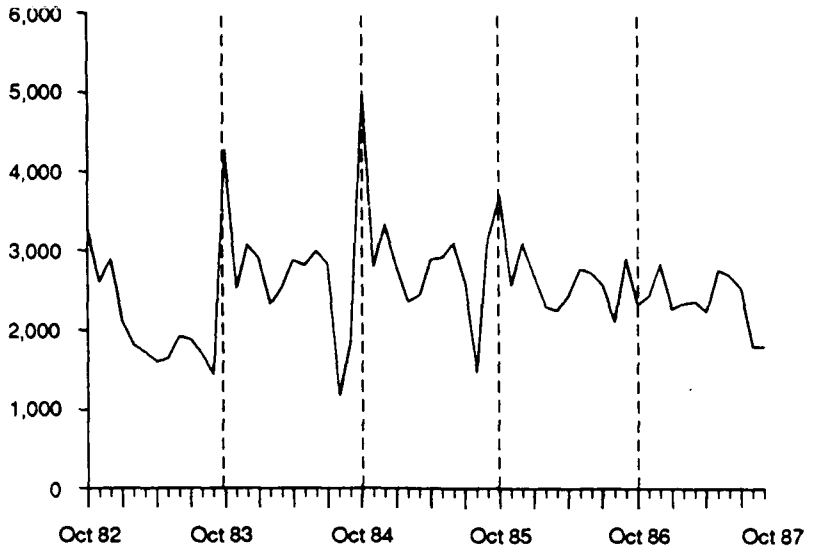


**Figure 36.** Enlisted rotational cost-move frequencies

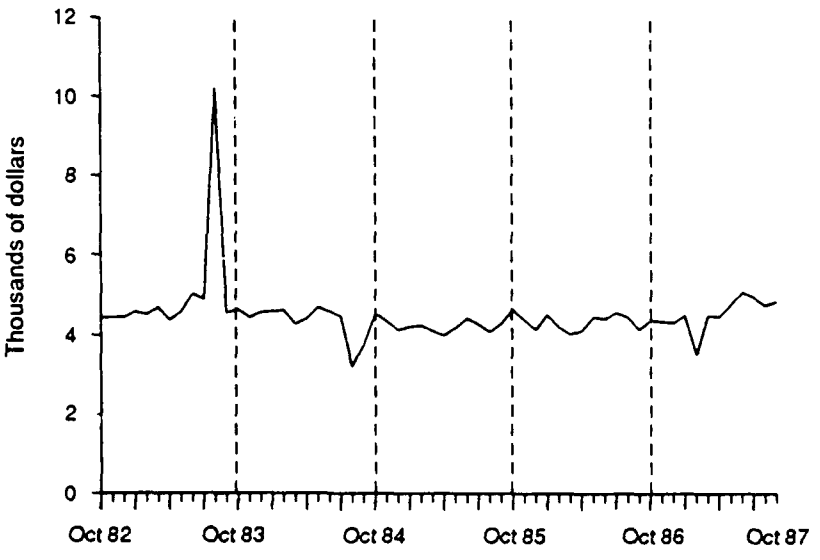


**Figure 37.** Average enlisted rotational move costs

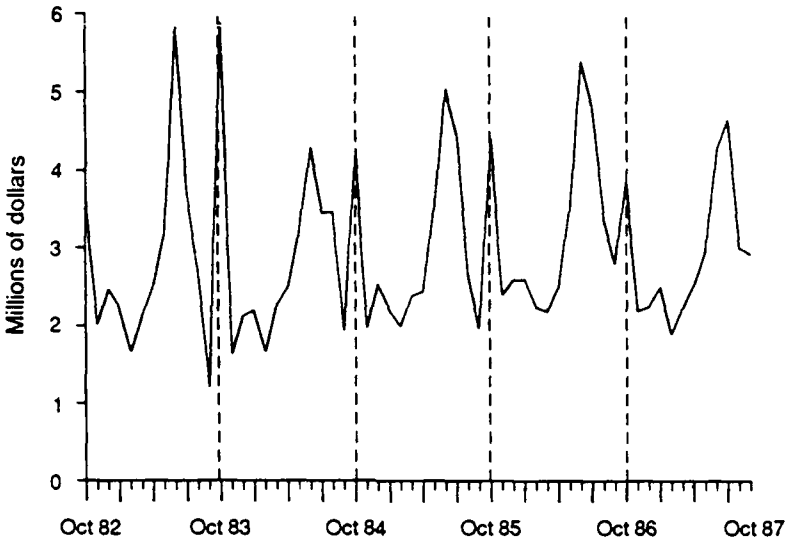


**Figure 38.** Officer operational move obligations

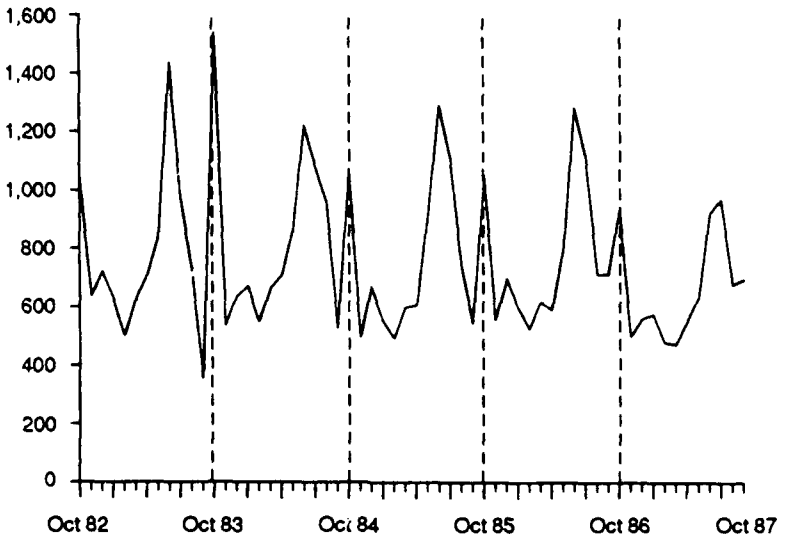


**Figure 39.** Officer operational cost-move frequencies

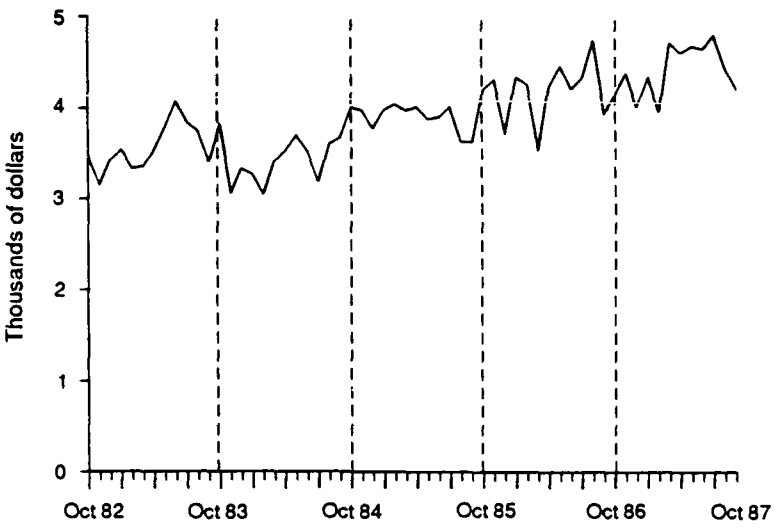


**Figure 40.** Average officer operational move costs

**Table 40.** Average costs of PCS moves, by fiscal year (dollars)

| | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| Officer moves | | | | | |
| Accession | 2,563 | 2,582 | 2,023 | 2,147 | 2,382 |
| Training | 3,098 | 2,936 | 2,767 | 3,477 | 3,239 |
| Operational | 3,617 | 3,472 | 3,901 | 4,192 | 4,422 |
| Rotational | 9,146 | 9,125 | 8,751 | 8,547 | 8,502 |
| Separation | 2,872 | 3,430 | 2,483 | 2,654 | 2,551 |
| Organized unit | 3,579 | 3,591 | 3,622 | 6,476 | 3,336 |
| Enlisted moves | | | | | |
| Accession | 601 | 587 | 623 | 602 | 599 |
| Training | 1,097 | 1,117 | 1,143 | 1,375 | 1,335 |
| Operational | 1,868 | 1,762 | 2,038 | 2,231 | 2,381 |
| Rotational | 4,955 | 4,432 | 4,253 | 4,341 | 4,516 |
| Separation | 680 | 618 | 641 | 727 | 750 |
| Organized unit | 2,331 | 2,287 | 2,114 | 2,801 | 2,397 |

**Table 41.** Standard deviation of costs of PCS moves, by fiscal year (dollars)

| | 1983 | 1984 | 1985 | 1986 | 1987 |
|---|---|---|---|---|---|
| Officer moves | | | | | |
| Accession | 454 | 701 | 535 | 683 | 394 |
| Training | 423 | 327 | 320 | 411 | 391 |
| Operational | 247 | 244 | 141 | 311 | 273 |
| Rotational | 651 | 797 | 370 | 592 | 737 |
| Separation | 202 | 537 | 662 | 833 | 2,397 |
| Organized unit | 914 | 1,115 | 774 | 2,596 | 4,307 |
| Enlisted moves | | | | | |
| Accession | 151 | 89 | 67 | 221 | 126 |
| Training | 79 | 82 | 75 | 176 | 352 |
| Operational | 103 | 110 | 150 | 172 | 387 |
| Rotational | 1,555 | 421 | 149 | 194 | 388 |
| Separation | 130 | 64 | 30 | 44 | 36 |
| Organized unit | 455 | 363 | 488 | 1,086 | 2,308 |

The above data are discouraging from a planner's perspective. Frequently, no clear patterns regarding average move costs persist over several years. In addition, the variation in the data, as described by the standard deviations, is comparatively large with respect to average costs. Overall, attaining a concise estimate of PCS obligations does not seem possible. One must therefore consider the many factors that influence PCS moves in order to arrive at reasonable projections of obligations.

### Selective Reenlistment Bonuses

SRB is intended to provide a monetary incentive for reenlisting to personnel in critical skills with high training costs. By applying SRB to particular skills on an as-needed basis, Navy management is able to redress force structure deficiencies in a cost-effective manner. As a corollary to this, SRB obligations are subject to many fluctuations. It is the nature of the SRB program for SRB levels to vary with the manning of ratings and Naval Enlisted Classifications (NECs). In addition, the SRB program is subject to cuts by the Navy in order to keep overall MPN obligations within authorized limits, and such policy actions cannot be predicted from merely a knowledge of inventories. These variations do not permit the concise estimation techniques pursued in this study.

The analysis of SRB begins with a review of obligations. Figure 41 shows monthly obligations for FY 1983 to FY 1987. The notable variation in obligations from one month to the next encourages a study of the factors that determine SRB obligations. The level of spending in

the SRB program varies with retention rates, the size of the pool of personnel who are eligible for reenlistment, reenlistment lengths, and the bonus level of SRB in individual ratings and NECs. SRB obligations cannot be accurately forecast without precise estimates of all of the above causal factors in SRB obligations. Unfortunately, these factors are difficult to predict, being subject to substantial monthly variations, mostly beyond the control of the Navy.

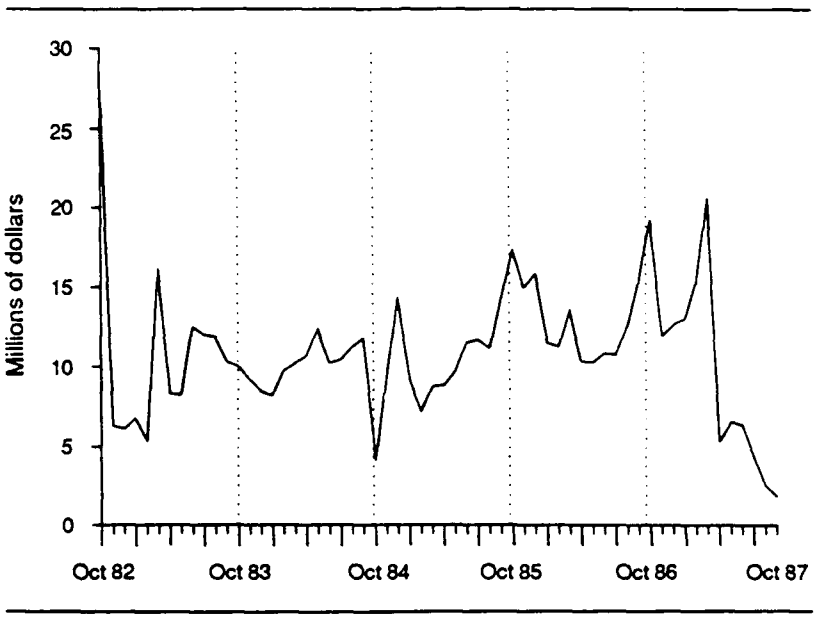


**Figure 41.** SRB obligations

Two figures illustrate how difficult it is to estimate the factors that drive SRB obligations. Figure 42 shows first-term reenlistments and eligibles, and figure 43 exhibits first-term reenlistment rates. The magnitude of monthly variations demonstrates the complexity involved in obtaining accurate forecasts in this area. Furthermore, the number of eligibles is not readily determined by examining EAOS dates on the enlisted master file. Personnel can reenlist at any time in the several months before their EAOS. The pool of eligibles in March 1987, for example, was not just the personnel with an EAOS in March 1987. Six-year obligors (6YOs) may decide to reenlist after four years of service or to exercise their obligated extension and decide about reenlistment at a later date. It is not clear how to handle 6YOs in the calculation of eligibles. To illustrate these difficulties, consider some of the plans produced by the SRB planners in OP-136. OP-136 produces a Phase Plan, which estimates the number of reenlistments for ratings/NECs receiving SRB, by SRB zone, on a monthly basis. The estimates are based on expected reenlistment rates and the computed number of eligibles. Table 42 compares the Phase Plan with actual data for zone totals in FY 1987. The table shows how difficult it is to estimate monthly reenlistments.

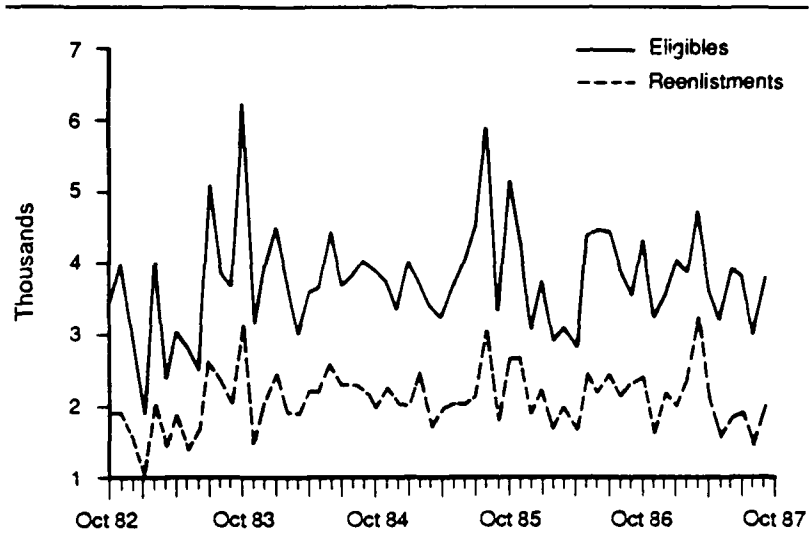


**Figure 42.** First-term retention (reenlistments and eligibles)

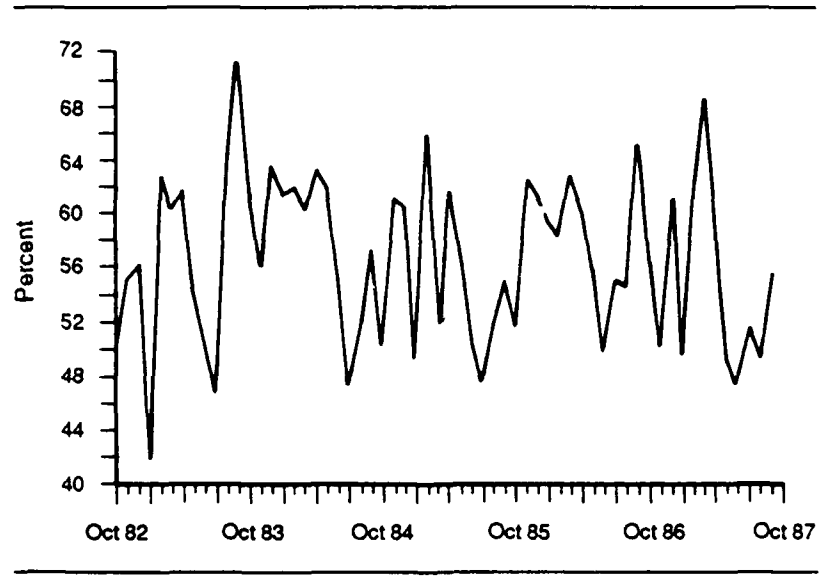


**Figure 43.** First-term reenlistment rates

**Table 42.** FY 1987 SRB reenlistments

| | | Zone A | | Zone B | | Zone C | |
|---|---|---|---|---|---|---|---|
| | | Plan | Actual | Plan | Actual | Plan | Actual |
| Oct | 1986 | 1,054 | 1,093 | 520 | 791 | 204 | 266 |
| Nov | 1986 | 1,100 | 777 | 552 | 498 | 223 | 211 |
| Dec | 1986 | 860 | 876 | 399 | 533 | 151 | 206 |
| Jan | 1987 | 1,048 | 837 | 500 | 560 | 186 | 214 |
| Feb | 1987 | 992 | 1,156 | 469 | 604 | 179 | 257 |
| Mar | 1987 | 627 | 1,622 | 313 | 836 | 111 | 302 |
| Apr | 1987 | 581 | 419 | 264 | 286 | 93 | 98 |
| May | 1987 | 600 | 529 | 283 | 373 | 99 | 223 |
| Jun | 1987 | 746 | 506 | 361 | 388 | 122 | 127 |
| Jul | 1987 | 811 | 442 | 405 | 293 | [illegible] | 90 |
| Aug | 1987 | 785 | 147 | 393 | 135 | [illegible] | 34 |
| Sep | 1987 | 872 | 164 | 472 | 87 | 182 | 17 |
| Total | | 10,076 | 8,568 | 4,931 | 5,384 | 1,842 | 2,045 |

SRB payments may also differ by NEC. Thus, it is often necessary to examine finer details than rating level. For example, in analyzing the length of reenlistments of ETs, 6YO ETs must be distinguished from non-6YO ETs. Figures 44 and 45, which are graphs of reenlistment length for the two communities, show fluctuations of more than a year in average reenlistment length. Finally, figure 46 shows how award levels have varied for one community—surface warfare ETs. Although SRB award levels are obviously within the control of the Navy, their substantial fluctuations are an additional complicating factor in any attempt to analyze patterns of obligations. Award levels must be considered on an individual rating/NEC level to understand their impact on obligations.

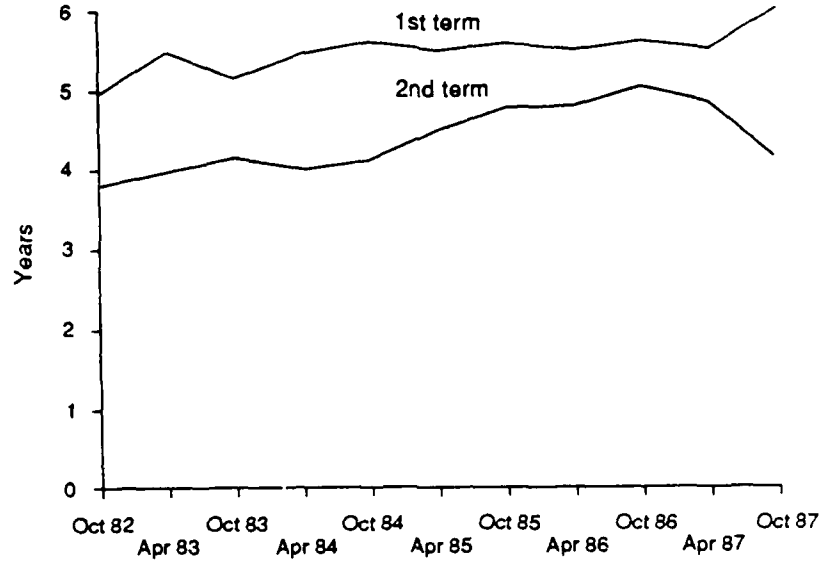


**Figure 44.** Average reenlistment length for 6YO ETs

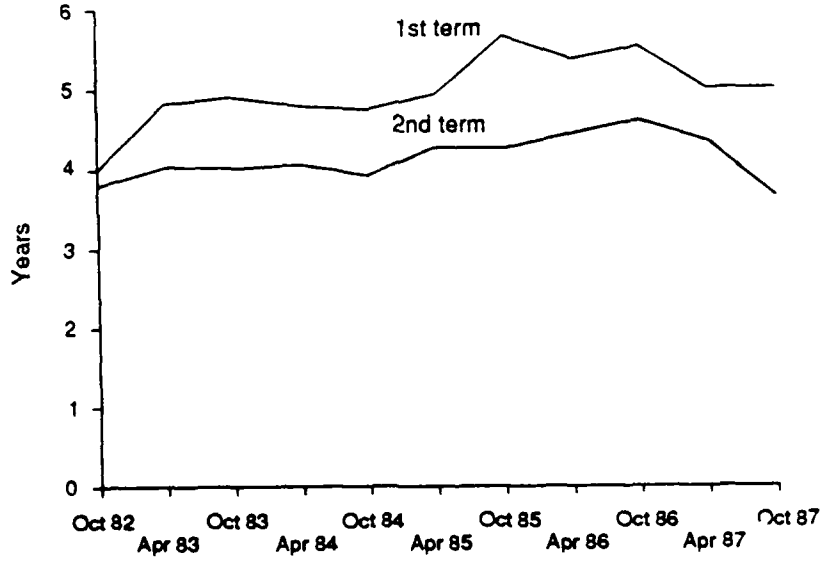


**Figure 45.** Average reenlistment length for non-6YO ETs

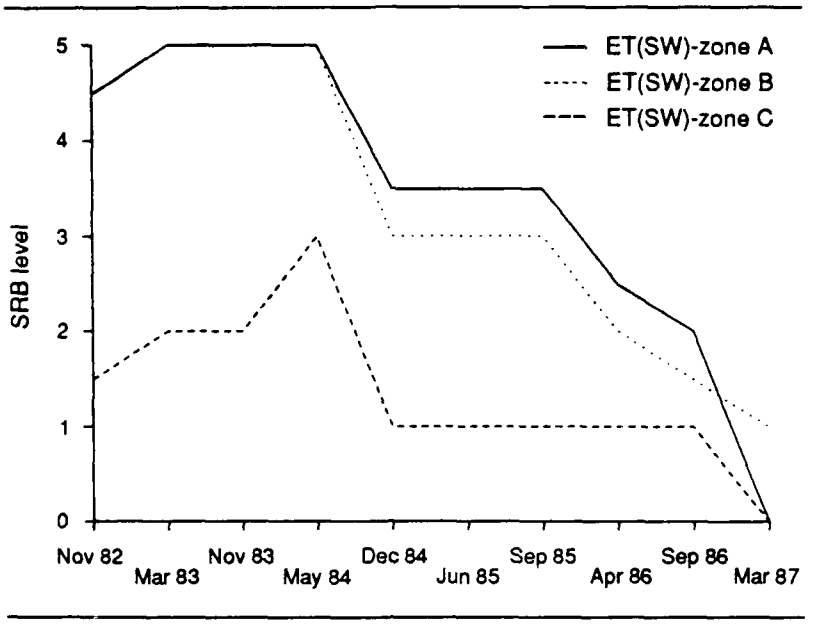


**Figure 46.** SRB award levels for ET(SW)

## VALIDATION OF ENLISTED BASIC PAY ESTIMATES

### Strength Plan Costing

Enlisted basic pay is the largest item in the MPN account. Moreover, other pay categories may be estimated directly from information regarding enlisted basic pay. Enlisted basic pay should therefore be considered first during an effort to validate and implement the estimates that were derived above. The validation effort used the strength plans produced regularly by OP-135. Strength plans provide the force structures that underlie the many budget submissions that occur during the budget cycle and contain monthly inventories disaggregated by pay grade. With the estimation technique developed in this report, basic pay obligations can be predicted from the strength plans. In particular, a number of strength plans for FY 1987 were costed out. (FY 1987 was chosen due to the problems in MPN execution that occurred in that year.) It is hoped that the analysis explains some of the causes of difficulties in 1987. The resulting estimates of enlisted basic pay were compared with analogous data from the budget submissions that correspond to the strength plans. The results of this comparison are displayed in table 43.

**Table 43.** Basic pay estimates from FY 1987 strength plans

| | | | Millions of dollars | | |
|---|---|---|---|---|---|
| Budget submission | Date of submission | End strength | Budget estimate | CNA estimate (no pay raise) | CNA estimate (3 percent pay raise in Jan 1987) |
| FY 1987 Presidential | Jan 1986 | 514,548 | 6,136 (no pay raise) | 6,153 | 6,292 |
| OSD | Sep 1986 | 508,848 | 6,129 (no pay raise) | 6,129 | 6,267 |
| FY 1988/1989 Presidential | Jan 1987 | 508,598 | 6,228 (3 percent in Jan 1987) | | 6,235 |
| NAVCOMP | Jan 1987 | 510,249 | | | 6,245 |
| Actual obligations/inventory | | 510,026 | 6,247 | | 6,243 |

The end-strength column reflects the changes in planned end strength that occur during a budget cycle. Obviously, such changes have an impact on obligations. During initial budget submissions, no allowance is made for a pay raise. A 3-percent pay raise in January 1987 was reflected in later budgets.

Table 43 illustrates the accuracy of the estimation methods. For example, the January 1986 budget submission contained $6.136 billion for enlisted basic pay. The corresponding estimate was $6.153 billion, which is a difference of $17 million—a .28-percent margin of error. The estimation technique was even more accurate for other strength plans.

**Review of FY 1987 Strength Plans**

The above discussion does not address the causes of deviations from strength plans, whence budgets. Analysis of these issues begins with a review of inventories. Each strength plan contains monthly end strength figures, which can be compared with actual data. Table 44 displays such information.

The data in table 44 are revealing, although they require some explanation. They do not agree with the corresponding information in table 43. The discrepancy occurs because officer candidates are included in table 43 but not in table 44. In addition, the fact that the first two months of the January 1987 plan are precisely what occurred is because actual data were available by the time the January 1987 plan was produced.

**Table 44.** FY 1987 enlisted end strength—planned vs. actual

| | Budget submission | | |
|---|---|---|---|
| | OSD plan Sep 1986 | Presidential Jan 1987 | Actual |
| Oct 1986 | 503,024 | 502,809 | 502,809 |
| Nov 1986 | 503,795 | 504,230 | 504,230 |
| Dec 1986 | 504,487 | 504,662 | 505,296 |
| Jan 1987 | 504,444 | 504,368 | 505,117 |
| Feb 1987 | 504,266 | 505,014 | 505,971 |
| Mar 1987 | 503,940 | 505,094 | 505,608 |
| Apr 1987 | 503,513 | 503,826 | 504,948 |
| May 1987 | 502,897 | 501,159 | 503,005 |
| Jun 1987 | 504,819 | 500,630 | 502,590 |
| Jul 1987 | 505,406 | 501,517 | 504,331 |
| Aug 1987 | 506,438 | 504,624 | 507,238 |
| Sep 1987 | 507,523 | 507,435 | 509,061 |

The January 1987 plan shows much the same end strength as the September 1986 plan, but substantial differences during the year. In particular, the January 1987 plan shows a decline in strength during the spring and early summer followed by a sharp rise in strength at the end of the fiscal year. This approach to force management was used to save money and will clearly save money if it can be successfully executed. In fact, end strength did not decline to the extent planned during the spring of 1987. It is true that this situation is complicated by the authorized raise in end strength, from 508,598 to 510,249, which occurred during the early months of 1987. However, due to fiscal constraints, the increase in authorized end strength was not properly funded, and merely exacerbated problems.

Accessions to and losses from the Navy cause variations in end strength. Accessions are to a large extent within the control of the Navy. Losses are not under Navy control and can only be influenced by pay raises, better working conditions, etc. The gains and losses data from strength plans are compared with what actually occurred in FY 1987 in tables 45 and 46.

**Table 45.** FY 1987 enlisted losses—planned vs. actual

| | Budget submission | | |
|---|---|---|---|
| | OSD plan Sep 1986 | Presidential Jan 1987 | Actual |
| Oct 1986 | 9,402 | 8,540 | 8,540 |
| Nov 1986 | 7,517 | 6,309 | 6 309 |
| Dec 1986 | 6,341 | 6,333 | 6,410 |
| Jan 1987 | 7,542 | 7,893 | 7,976 |
| Feb 1987 | 7,034 | 6,589 | 6,048 |
| Mar 1987 | 7,197 | 6,913 | 7,791 |
| Apr 1987 | 7,004 | 7,946 | 7,466 |
| May 1987 | 7,300 | 8,684 | 7,741 |
| Jun 1987 | 7,205 | 9,229 | 8,745 |
| Jul 1987 | 9,361 | 8,554 | 8,382 |
| Aug 1987 | 9,349 | 7,403 | 7,667 |
| Sep 1987 | 8,857 | 7,692 | 7,406 |
| Total | 94,109 | 92,085 | 90,481 |

**Table 46.** FY 1987 enlisted gains—planned vs. actual

| | Budget submission | | |
|---|---|---|---|
| | OSD plan Sep 1986 | Presidential Jan 1987 | Actual |
| Oct 1986 | 9,044 | 8,155 | 8,155 |
| Nov 1986 | 8,288 | 7,730 | 7,730 |
| Dec 1986 | 7,033 | 6,765 | 7,476 |
| Jan 1987 | 7,499 | 7,599 | 7,797 |
| Feb 1987 | 6,856 | 7,235 | 6,902 |
| Mar 1987 | 6,871 | 6,993 | 7,428 |
| Apr 1987 | 6,577 | 6,678 | 6,806 |
| May 1987 | 6,684 | 6,017 | 5,798 |
| Jun 1987 | 9,127 | 8,700 | 8,330 |
| Jul 1987 | 9,948 | 9,441 | 10,123 |
| Aug 1987 | 10,381 | 10,510 | 10,574 |
| Sep 1987 | 9,942 | 10,503 | 9,229 |
| Total | 98,250 | 96,326 | 96,348 |

The above two tables throw further light on the cause of fiscal difficulties in 1987. The January 1987 plan shows fewer planned losses than the September 1986 plan (based on experienced retention rates, etc.). Fewer total annual losses lead to increased obligations, unless one has more losses earlier in the fiscal year and many fewer losses later in the fiscal year. The January 1987 plan exhibits this method of constraining obligations, higher losses in the spring months and lower losses in the summer months, when compared to the September 1986 plan. Unfortunately, not only did the Navy not have as many losses than planned, they also did not "front load" the losses.

An analogous situation occurred with gains. The Navy saves money if it brings in accessions in the later months of a fiscal year. The January 1987 plan shows a back-loading of accessions, as well as a decline in total accessions when compared with the September 1986 plan. The actual data show that the decline in total accessions was attained, but there were problems with their back-loading.

The problem with not meeting goals for gains and losses is the cumulative impact. If someone reenlists instead of leaving the Navy, that individual will be paid in each month for the next few years. A similar consideration applies to having an excess of accessions. Thus, it is important to look at the cumulative effect of deviations in gains and losses from strength plans.

It would be hoped that a higher than expected number of losses in one month would be compensated by a lower than expected number in the next month, etc. If such compensating actions do not occur, there will be a long-term impact on fiscal obligations. Figures 47 and 48 display the cumulative deviations of the January 1987 strength plan from actual data, for losses and gains, respectively. The area between the graph and the x-axis (the zero line) represents the impact of deviations from plans on obligations. Figure 47 shows that actual cumulative losses were less than anticipated, causing increased expenditures. Similarly, cumulative accessions were consistently above planned levels, also driving up costs.

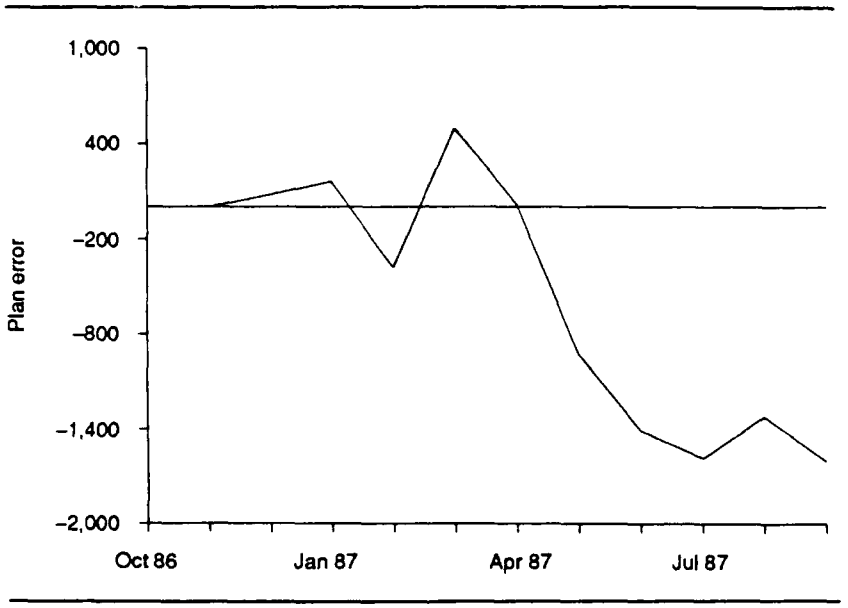


**Figure 47.** FY 87 loss planning accuracy (cumulative actuals minus planned)

## Fiscal Impact of Deviations from Strength Plans

It is of obvious interest to Navy management to have an appreciation of the fiscal impact of deviations from strength plans. For example, end strength may be 1,000 higher than planned in a particular month, caused by fewer than anticipated losses. This will have an impact on MPN obligations for the fiscal year, but how much? By means of the techniques described above, such questions can be answered. An example will clarify things.

The FY 1987 strength plan of January 1987 provides a basic pay cost estimate of $6.235 billion (see table 43). The strength plan anticipates 6,589 losses in February 1987. In reality, there were 6,048 losses in that February. If the strength plan is changed by that one entry and all other gains, losses, etc., are unchanged, the resulting changes in force size through the remainder of FY 1987 can be computed. This modified strength plan can be costed out. It results in an increase of $3.3 million in obligations. Similarly, if 500 gains are added to June

accessions and 500 are subtracted from September accessions, an increase of $1 million in obligations can be inferred.

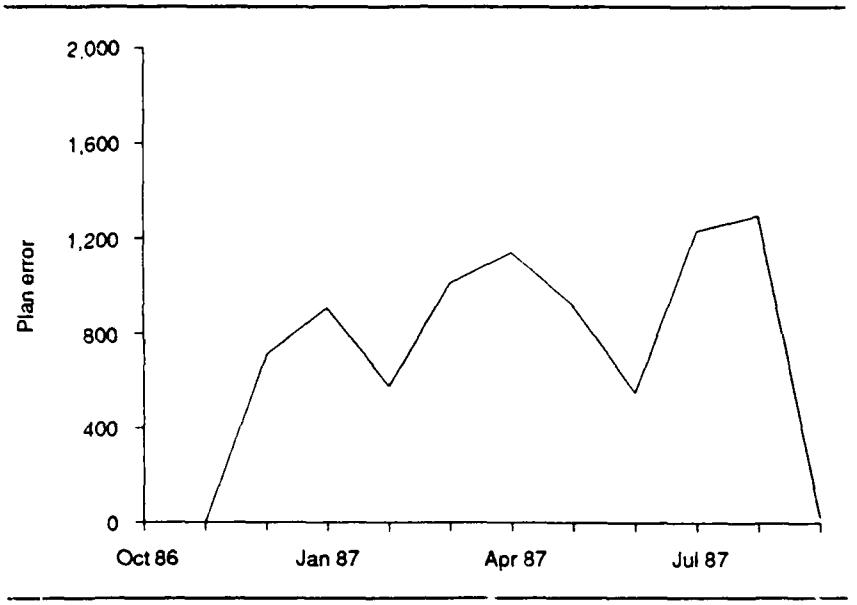


**Figure 48.** FY 87 gains planning accuracy (cumulative actuals minus planned)

An automated method of computing the fiscal impact of force structure variations is provided in [4], which describes some spreadsheets that estimate a variety of MPN pay categories from strength plans. In particular, these spreadsheets estimate basic pay, RPA, BAQ, and FICA for both officers and enlisted personnel, and officer BAS. The spreadsheets enable one to see the impact of variations in force structure on obligations.

## ANALYSIS OF FY 1988 ENLISTED PAY OBLIGATIONS

During May 1988, enlisted basic pay obligations for FY 1988 were analyzed. The analysis provided a review of MPN execution as it was happening and supplied another way to review the accuracy of the forecast methods. Following the guidelines of the analysis of FY 1987 obligations, a number of strength plans were costed out. The results of this estimation are displayed in table 47.

For the most part, table 47 is like table 43. At the time of the cost estimate, actual data were available for the first two quarters of FY 1988. The strength plans of April 1988 reflected this situation, having real data for the first six months of the fiscal year and planned data for the remainder. The strength plan for the entire year was costed out. This estimate may be compared with budgeted obligations to see whether execution is on track. In summary, table 47 shows that

estimated enlisted pay obligations for FY 1988 appear to be on target, given the information available as of the middle of the year.

**Table 47.** Enlisted basic pay estimates for FY 1988

| | | | Millions of dollars | | |
|---|---|---|---|---|---|
| Budget submission | Date of submission | End strength | Budget estimate | CNA estimate (no pay raise) | CNA estimate (2 percent pay raise in Jan 1988) |
| FY 1988/1989 Presidential | Feb 1987 | 513,725 | 6,398 (no pay raise) | 6,375 | 6,471 |
| FY 1988/1989 Presidential | Jan 1988 | 515,815 | 6,430 (2 percent in Jan 1988) | | 6,409 |
| April 1988 strength plan (includes actual data to Mar 1988) | Apr 1988 | | 6,430 | | 6,421 |

It is also of interest to review the strength plans that underlie the force structure for FY 1988. The strength plans of January and April 1988 can be compared in order to understand how plans change as the year progresses. Table 48 compares end strength data from these two plans. The data from the April plan are divided in two: actual data for the first two quarters and projected strength for the remainder of the fiscal year. The January 1988 plan shows a drop in strength during the middle months of the year with a sharp rise towards the end of the year. Actual data through March 1988 show the plan being followed.

The decline in strength during the middle of FY 1988 was caused by the "early out" program in effect for this fiscal year. The impact of the program can be seen by considering the losses that correspond to the data in table 48. Table 49 contains this information and shows that the January 1988 plan anticipated a sharp rise in losses during April and May. As actual data have become available, it appears that losses began to rise in March 1988. At the time the "early out" program was initiated, the magnitude of its effect could only be accurately forecast. It appears that the program may have caused more personnel to leave the Navy than was desired.

**Table 48.** FY 1988 enlisted end strength

| | Budget submission | | |
|---|---|---|---|
| | Jan 1988 presidential | Apr 1988 actual | Apr 1988 plan |
| Oct 1987 | 509,219 | 509,219 | |
| Nov 1987 | 509,516 | 509,516 | |
| Dec 1987 | 508,479 | 508,479 | |
| Jan 1988 | 508,064 | 508,114 | |
| Feb 1988 | 507,414 | 507,447 | |
| Mar 1988 | 507,126 | 506,453 | |
| Apr 1988 | 500,403 | | 500,446 |
| May 1988 | 496,925 | | 497,427 |
| Jun 1988 | 501,878 | | 502,667 |
| Jul 1988 | 505,756 | | 506,866 |
| Aug 1988 | 510,353 | | 511,786 |
| Sep 1988 | 514,881 | | 514,880 |

**Table 49.** FY 1988 enlisted losses

| | Budget submission | | |
|---|---|---|---|
| | Jan 1988 presidential | Apr 1988 actual | Apr 1988 plan |
| Oct 1987 | 8,087 | 8,353 | |
| Nov 1987 | 6,983 | 7,195 | |
| Dec 1987 | 7,309 | 7,516 | |
| Jan 1988 | 7,973 | 8,145 | |
| Feb 1988 | 8,053 | 7,859 | |
| Mar 1988 | 7,596 | 9,304 | |
| Apr 1988 | 13,438 | | 12,876 |
| May 1988 | 10,147 | | 9,755 |
| Jun 1988 | 5,468 | | 5,250 |
| Jul 1988 | 7,090 | | 6,832 |
| Aug 1988 | 6,838 | | 6,568 |
| Sep 1988 | 6,580 | | 6,289 |
| Total | 95,562 | | 95,942 |

## CONCLUSIONS AND RECOMMENDATIONS

This study has investigated methods that provide Navy management with succinct and accurate forecasts of MPN obligations. The objective has been to provide tools to an individual who wants an overview of the MPN account, without too many details. The study results indicate that such a capability is available for only some of the so-called strength-related variables. In particular, reasonably accurate estimates of a variety of pay categories can be obtained based on knowledge of strength plans. The pay categories that are open to such an estimation process are basic pay, RPA, BAQ, and FICA for both officers and enlisted personnel, and officer BAS. Other pay categories exhibit too much variability to be amenable to such forecasting methods.

The value of the above estimation techniques is magnified by the size of the pay categories that are addressed. Basic pay, RPA, BAQ, and FICA account for more than 82 percent of total MPN obligations. Consequently, a large majority of the MPN account is amenable to succinct analysis.

From both practical and statistical standpoints, the estimation methods are as accurate as one can expect to obtain. The estimation techniques provide confidence intervals that are frequently less than 1 percent of obligations in span. For example, one has 95 percent confidence that a three-month forecast of enlisted basic pay will be within $16 million of the actual value. Three months of enlisted basic pay obligations amount to approximately $1.5 billion, which is accurate to within one-tenth of 1 percent. The complexity of the Navy's information system does not allow any greater precision. Indeed, the attained accuracy is a tribute to the viability of the methods.

The Navy needs to manage its resources very carefully because it is illegal to overexpend authorizations. Strength and budget plans should therefore err on the side of caution. It makes more sense to plan for a marginal under-obligation of authorized funds and make adjustments as the year progresses, than to plan to spend every dime that is authorized.

Navy managers may save money by varying the timing of losses, gains, and promotions. In previous years, it was a common practice for strength plans to contain some slack in promotion, accessions, and losses plans, which could be the source of money savings if necessary. Recent budget constraints, however, limit this flexibility, taking away required leeway and forcing undesirable management decisions should events not precisely follow plans. For example, the extraordinary "early out" program for FY 1988 was partially caused by the lack of more standard options, when budget restrictions caused cost cutting (strength plans already contained back-loaded accessions, etc.). As long as the Navy plans to spend every dime that is authorized and has strength plans that allow little room for maneuvering, problems with managing the execution of the MPN account can be expected to reoccur.

The study stimulated a variety of opinions regarding how the Navy could better manage the MPN account. The first opinion addresses the somewhat fragmented manner in which Navy personnel management operates. The management of the MPN account requires the knowledge and input of many organizations within OP-01 and NMPC. Historically, these organizations have operated independently and have come together only once a month in order to present a briefing to the Chief of Naval Personnel. Recent organizational changes within OP-13, toward instituting an office to coordinate the management of MPN account execution, are to be applauded. This should facilitate the pulling together of the disparate information needed in this area.

In addition, the Navy should consider the adequacy of the reports and other information that are being provided to managers of the MPN account. For example, estimation of VHA obligations is inhibited by a lack of a report that would compute such obligations from a geographical distribution of personnel and VHA rate tables. ADP support could likely be improved in a number of areas. Since ADP support involves many organizations, establishing a coordinating function within OP-13 will help bring such problems to light.

## REFERENCES


[1] Naval Personnel Research and Development Center, *The Development of the Budget Obligation Analysis and Tracking System (BOATS) and Its Role in Military Personnel, Navy (MPN) Budget Management*, Draft Report, by Susan J. Pinciaro, Aug 1987

[2] Henri Theil. *Principles of Econometrics*. Wiley, 1979

[3] OSD Report, *Military Compensation Background Papers*, 3rd edition, Jun 1987

[4] CNA Information Manual 26, *User's Guide to the MPN Account Management Spreadsheets*, by Mark B. Geis and David M. Rodney, Sep 1988

# APPENDIX A

# STRENGTH DATA

# APPENDIX A

## STRENGTH DATA

The following data are monthly end strengths for FY 1983 to FY 1987. The data were obtained from the officer and enlisted strength planners in OP-130 and OP-135, respectively. The data do not exactly agree with inventory counts that may be obtained from officer and enlisted master files. The strength planners' data are considered to be more accurate by OP-01 staff and are used for management purposes.

**Table A-1.** Monthly officer end strength

| Month | O-7+ | O-6 | O-5 | O-4 | O-3 | O-2 | O-1 | W-4 | W-3 | W-2 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sep 1982 | 251 | 3,811 | 7,752 | 12,938 | 19,027 | 10,269 | 10,323 | 459 | 1,245 | 1,198 | 67,273 |
| Oct 1982 | 250 | 3,812 | 7,341 | 12,728 | 18,569 | 10,194 | 10,732 | 459 | 1,252 | 1,293 | 66,630 |
| Nov 1982 | 250 | 3,775 | 7,284 | 12,717 | 18,742 | 10,342 | 10,743 | 448 | 1,246 | 1,282 | 66,829 |
| Dec 1982 | 248 | 3,739 | 7,261 | 12,694 | 18,631 | 10,430 | 10,719 | 443 | 1,240 | 1,278 | 66,683 |
| Jan 1983 | 250 | 3,764 | 7,345 | 12,800 | 18,730 | 10,105 | 10,812 | 443 | 1,239 | 1,275 | 66,763 |
| Feb 1983 | 250 | 3,748 | 7,323 | 12,780 | 18,778 | 10,441 | 10,712 | 437 | 1,237 | 1,274 | 66,980 |
| Mar 1983 | 249 | 3,733 | 7,312 | 12,749 | 18,860 | 10,639 | 10,654 | 431 | 1,210 | 1,300 | 67,137 |
| Apr 1983 | 250 | 3,760 | 7,429 | 12,787 | 18,707 | 11,015 | 10,341 | 601 | 1,287 | 1,025 | 67,202 |
| May 1983 | 250 | 3,796 | 7,486 | 12,832 | 19,040 | 12,249 | 10,042 | 595 | 1,280 | 1,045 | 68,615 |
| Jun 1983 | 248 | 3,821 | 7,572 | 12,695 | 20,632 | 10,559 | 10,453 | 597 | 1,293 | 1,049 | 68,919 |
| Jul 1983 | 247 | 3,779 | 7,551 | 12,599 | 20,480 | 10,802 | 10,370 | 590 | 1,301 | 1,108 | 68,827 |
| Aug 1983 | 250 | 3,753 | 7,584 | 12,611 | 20,319 | 10,735 | 10,564 | 590 | 1,304 | 1,151 | 68,861 |
| Sep 1983 | 250 | 3,753 | 7,669 | 12,775 | 20,186 | 10,583 | 10,239 | 601 | 1,292 | 1,146 | 68,494 |
| Oct 1983 | 252 | 3,701 | 7,580 | 12,820 | 20,281 | 10,614 | 10,443 | 599 | 1,246 | 1,251 | 68,787 |
| Nov 1983 | 252 | 3,666 | 7,551 | 12,798 | 20,260 | 10,861 | 10,513 | 586 | 1,238 | 1,274 | 68,999 |
| Dec 1983 | 252 | 3,665 | 7,540 | 12,812 | 20,263 | 10,846 | 10,492 | 580 | 1,233 | 1,305 | 68,988 |
| Jan 1984 | 252 | 3,674 | 7,567 | 12,847 | 20,461 | 10,566 | 10,475 | 575 | 1,227 | 1,304 | 68,948 |
| Feb 1984 | 252 | 3,685 | 7,599 | 12,890 | 20,349 | 10,901 | 10,308 | 572 | 1,230 | 1,292 | 69,078 |
| Mar 1984 | 252 | 3,724 | 7,623 | 12,968 | 20,155 | 10,901 | 10,227 | 570 | 1,222 | 1,289 | 68,931 |
| Apr 1984 | 252 | 3,753 | 7,652 | 13,003 | 20,306 | 10,949 | 9,850 | 714 | 1,356 | 978 | 68,813 |
| May 1984 | 252 | 3,780 | 7,673 | 13,037 | 20,478 | 11,621 | 10,377 | 710 | 1,347 | 928 | 70,203 |
| Jun 1984 | 252 | 3,817 | 7,680 | 13,007 | 21,623 | 11,036 | 9,901 | 701 | 1,336 | 964 | 70,317 |
| Jul 1984 | 252 | 3,693 | 7,612 | 12,842 | 21,727 | 10,952 | 9,664 | 694 | 1,320 | 998 | 69,754 |
| Aug 1984 | 252 | 3,685 | 7,630 | 12,827 | 21,696 | 10,722 | 9,647 | 719 | 1,274 | 1,031 | 69,483 |
| Sep 1984 | 253 | 3,707 | 7,626 | 12,855 | 21,248 | 10,584 | 9,501 | 942 | 978 | 1,162 | 68,856 |
| Oct 1984 | 252 | 3,682 | 7,777 | 13,136 | 20,889 | 10,578 | 9,799 | 928 | 983 | 1,223 | 69,247 |
| Nov 1984 | 252 | 3,673 | 7,770 | 13,179 | 20,774 | 10,655 | 9,909 | 936 | 958 | 1,221 | 69,327 |
| Dec 1984 | 252 | 3,688 | 7,781 | 13,238 | 20,741 | 10,766 | 9,744 | 935 | 953 | 1,220 | 69,318 |
| Jan 1985 | 252 | 3,705 | 7,784 | 13,304 | 20,526 | 10,652 | 9,760 | 933 | 950 | 1,218 | 69,084 |
| Feb 1985 | 252 | 3,711 | 7,775 | 13,354 | 20,382 | 10,721 | 9,894 | 928 | 946 | 1,211 | 69,174 |
| Mar 1985 | 253 | 3,717 | 7,777 | 13,413 | 20,413 | 10,662 | 10,021 | 919 | 875 | 1,248 | 69,298 |

**Table A-1.** (Continued)

| Month | O-7+ | O-6 | O-5 | O-4 | O-3 | O-2 | O-1 | W-4 | W-3 | W-2 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Apr 1985 | 253 | 3,738 | 7,801 | 13,400 | 20,639 | 10,404 | 10,029 | 1,102 | 769 | 1,187 | 69,322 |
| May 1985 | 253 | 3,758 | 7,816 | 13,392 | 21,015 | 11,556 | 10,004 | 1,090 | 749 | 1,232 | 70,865 |
| Jun 1985 | 253 | 3,790 | 7,843 | 13,371 | 21,940 | 10,745 | 9,972 | 1,097 | 843 | 1,153 | 71,007 |
| Jul 1985 | 253 | 3,738 | 7,834 | 13,261 | 22,116 | 10,397 | 10,109 | 1,105 | 801 | 1,200 | 70,814 |
| Aug 1985 | 251 | 3,748 | 7,825 | 13,215 | 21,964 | 10,484 | 10,074 | 1,090 | 808 | 1,215 | 70,674 |
| Sep 1985 | 249 | 3,699 | 7,764 | 13,139 | 22,048 | 10,480 | 10,117 | 1,079 | 843 | 1,239 | 70,657 |
| Oct 1985 | 252 | 3,694 | 7,800 | 13,212 | 21,901 | 10,387 | 10,022 | 1,077 | 873 | 1,187 | 70,405 |
| Nov 1985 | 252 | 3,686 | 7,785 | 13,216 | 21,795 | 10,389 | 10,201 | 1,067 | 863 | 1,187 | 70,441 |
| Dec 1985 | 252 | 3,688 | 7,796 | 13,214 | 21,786 | 10,438 | 10,148 | 1,057 | 859 | 1,184 | 70,422 |
| Jan 1986 | 252 | 3,696 | 7,804 | 13,240 | 21,690 | 10,422 | 10,203 | 1,056 | 843 | 1,184 | 70,390 |
| Feb 1986 | 252 | 3,700 | 7,800 | 13,243 | 21,676 | 10,373 | 10,379 | 1,046 | 836 | 1,184 | 70,489 |
| Mar 1986 | 252 | 3,710 | 7,794 | 13,243 | 21,716 | 10,285 | 10,665 | 1,044 | 814 | 1,149 | 70,672 |
| Apr 1986 | 252 | 3,727 | 7,806 | 13,266 | 21,765 | 10,117 | 10,704 | 1,188 | 645 | 1,165 | 70,635 |
| May 1986 | 252 | 3,747 | 7,818 | 13,293 | 21,856 | 11,637 | 10,802 | 1,179 | 672 | 1,174 | 72,430 |
| Jun 1986 | 252 | 3,830 | 7,899 | 13,379 | 22,509 | 10,696 | 11,023 | 1,168 | 696 | 1,189 | 72,641 |
| Jul 1986 | 252 | 3,725 | 7,826 | 13,260 | 22,858 | 10,180 | 10,968 | 1,149 | 716 | 1,213 | 72,147 |
| Aug 1986 | 252 | 3,733 | 7,805 | 13,274 | 22,775 | 10,117 | 11,204 | 1,157 | 721 | 1,229 | 72,267 |
| Sep 1986 | 251 | 3,709 | 7,765 | 13,382 | 22,433 | 9,687 | 11,695 | 1,125 | 810 | 1,194 | 72,051 |
| Oct 1986 | 253 | 3,698 | 7,758 | 13,394 | 22,480 | 9,668 | 11,423 | 1,120 | 907 | 1,103 | 71,804 |
| Nov 1986 | 253 | 3,680 | 7,733 | 13,363 | 22,289 | 9,723 | 11,555 | 1,095 | 910 | 1,085 | 71,686 |
| Dec 1986 | 255 | 3,689 | 7,733 | 13,369 | 22,230 | 9,914 | 11,388 | 1,081 | 921 | 1,062 | 71,642 |
| Jan 1987 | 255 | 3,703 | 7,750 | 13,402 | 22,245 | 9,773 | 11,400 | 1,068 | 920 | 1,059 | 71,575 |
| Feb 1987 | 254 | 3,712 | 7,744 | 13,393 | 22,182 | 9,873 | 11,441 | 1,049 | 913 | 1,059 | 71,620 |
| Mar 1987 | 253 | 3,719 | 7,753 | 13,400 | 22,234 | 9,840 | 11,326 | 1,037 | 890 | 1,061 | 71,513 |
| Apr 1987 | 254 | 3,734 | 7,776 | 13,433 | 22,509 | 9,544 | 11,194 | 1,130 | 756 | 1,086 | 71,416 |
| May 1987 | 254 | 3,747 | 7,792 | 13,451 | 22,586 | 10,979 | 11,321 | 1,107 | 779 | 1,088 | 73,104 |
| Jun 1987 | 254 | 3,830 | 7,851 | 13,390 | 23,563 | 10,087 | 11,317 | 1,089 | 796 | 1,086 | 73,263 |
| Jul 1987 | 256 | 3,718 | 7,800 | 13,264 | 24,063 | 9,5[illegible] | 11,188 | 1,065 | 815 | 1,087 | 72,757 |
| Aug 1987 | 252 | 3,705 | 7,785 | 13,239 | 23,968 | 9,499 | 11,066 | 1,053 | 830 | 1,083 | 72,480 |
| Sep 1987 | 253 | 3,674 | 7,805 | 13,129 | 23,710 | 9,445 | 11,064 | 1,035 | 855 | 1,081 | 72,051 |

**Table A-2.** Monthly enlisted end strength

| Month | E-9 | E-8 | E-7 | E-6 | E-5 | E-4 | E-3 | E-2 | E-1 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Sep 1982 | 3,655 | 8,467 | 30,157 | 64,910 | 87,857 | 101,844 | 88,404 | 46,506 | 37,987 | 469,787 |
| Oct 1982 | 3,598 | 8,314 | 29,777 | 64,421 | 87,947 | 101,489 | 93,217 | 44,375 | 42,189 | 475,327 |
| Nov 1982 | 3,563 | 8,173 | 29,477 | 63,993 | 88,112 | 100,896 | 95,001 | 43,515 | 42,836 | 475,566 |
| Dec 1982 | 3,557 | 8,119 | 29,376 | 68,310 | 94,424 | 92,802 | 95,082 | 43,178 | 43,665 | 478,513 |
| Jan 1983 | 3,514 | 8,036 | 29,620 | 67,440 | 93,402 | 92,777 | 97,529 | 43,775 | 44,897 | 480,990 |
| Feb 1983 | 3,485 | 7,972 | 29,460 | 67,136 | 92,426 | 92,791 | 100,927 | 44,966 | 39,521 | 478,684 |
| Mar 1983 | 3,452 | 7,913 | 29,323 | 66,932 | 92,040 | 92,922 | 105,188 | 45,943 | 38,993 | 482,706 |
| Apr 1983 | 3,415 | 7,830 | 29,124 | 66,553 | 91,402 | 92,855 | 108,069 | 46,938 | 35,301 | 481,487 |
| May 1983 | 3,365 | 7,716 | 28,840 | 66,107 | 90,508 | 92,325 | 110,574 | 47,022 | 33,815 | 480,272 |
| Jun 1983 | 3,864 | 9,180 | 26,523 | 71,506 | 100,672 | 96,118 | 91,909 | 47,524 | 33,608 | 480,904 |
| Jul 1983 | 3,812 | 9,051 | 26,194 | 71,087 | 98,274 | 99,062 | 92,216 | 45,936 | 33,848 | 479,480 |
| Aug 1983 | 3,782 | 8,971 | 30,082 | 66,908 | 96,901 | 103,278 | 91,512 | 45,484 | 33,776 | 480,694 |
| Sep 1983 | 3,785 | 8,960 | 30,389 | 67,527 | 95,623 | 110,049 | 88,314 | 44,296 | 34,578 | 483,521 |
| Oct 1983 | 3,721 | 8,746 | 30,293 | 68,006 | 97,277 | 105,164 | 94,043 | 41,052 | 34,334 | 482,636 |
| Nov 1983 | 3,712 | 8,635 | 30,482 | 68,733 | 99,481 | 100,984 | 96,350 | 41,625 | 33,294 | 483,294 |
| Dec 1983 | 3,728 | 8,544 | 30,706 | 69,585 | 101,882 | 99,909 | 96,832 | 38,567 | 33,568 | 483,321 |
| Jan 1984 | 3,760 | 8,577 | 30,697 | 69,705 | 101,714 | 97,287 | 101,544 | 37,833 | 31,746 | 482,863 |
| Feb 1984 | 3,820 | 8,673 | 30,762 | 69,948 | 101,951 | 98,315 | 102,173 | 37,020 | 31,781 | 484,443 |
| Mar 1984 | 3,882 | 8,784 | 30,779 | 70,304 | 102,145 | 98,700 | 103,018 | 37,065 | 33,075 | 487,752 |
| Apr 1984 | 3,901 | 8,850 | 30,839 | 70,272 | 102,045 | 99,301 | 103,180 | 37,298 | 32,710 | 488,396 |
| May 1984 | 3,932 | 8,921 | 30,877 | 70,278 | 101,821 | 99,970 | 103,035 | 37,670 | 32,800 | 489,304 |
| Jun 1984 | 3,998 | 9,025 | 30,997 | 74,974 | 100,096 | 100,396 | 100,166 | 38,079 | 35,694 | 493,425 |
| Jul 1984 | 3,932 | 8,777 | 30,993 | 74,031 | 98,318 | 99,946 | 100,889 | 37,400 | 35,389 | 489,675 |
| Aug 1984 | 3,950 | 8,668 | 31,163 | 73,307 | 96,843 | 99,786 | 102,888 | 36,990 | 36,308 | 489,903 |
| Sep 1984 | 4,056 | 8,875 | 30,695 | 73,157 | 97,720 | 105,575 | 96,674 | 37,366 | 35,705 | 489,823 |
| Oct 1984 | 4,069 | 8,939 | 30,653 | 73,849 | 97,388 | 103,922 | 97,071 | 37,238 | 34,590 | 487,727 |
| Nov 1984 | 4,081 | 9,021 | 30,685 | 74,660 | 97,279 | 103,116 | 97,629 | 37,621 | 33,109 | 487,201 |
| Dec 1984 | 4,126 | 9,125 | 30,781 | 76,588 | 98,033 | 99,645 | 98,107 | 37,861 | 32,553 | 486,819 |
| Jan 1985 | 4,129 | 9,232 | 30,712 | 76,621 | 98,353 | 99,744 | 97,009 | 38,841 | 34,131 | 488,772 |
| Feb 1985 | 4,193 | 9,403 | 30,783 | 76,842 | 98,940 | 100,327 | 96,667 | 40,300 | 31,874 | 489,329 |
| Mar 1985 | 4,247 | 9,552 | 30,980 | 76,841 | 99,296 | 100,720 | 95,572 | 40,454 | 33,119 | 490,781 |
| Apr 1985 | 4,295 | 9,718 | 31,207 | 77,031 | 99,889 | 100,835 | 95,308 | 41,077 | 33,279 | 492,639 |
| May 1985 | 4,313 | 9,813 | 31,341 | 77,104 | 100,198 | 100,756 | 94,810 | 41,395 | 32,216 | 491,946 |
| Jun 1985 | 4,342 | 9,829 | 31,554 | 77,228 | 100,349 | 100,499 | 93,835 | 41,585 | 34,250 | 493,471 |
| Jul 1985 | 4,398 | 9,792 | 31,837 | 77,739 | 100,277 | 98,671 | 93,727 | 40,819 | 36,234 | 493,494 |
| Aug 1985 | 4,421 | 9,722 | 31,974 | 78,118 | 99,819 | 96,998 | 95,096 | 40,670 | 36,851 | 493,669 |
| Sep 1985 | 4,517 | 9,770 | 32,850 | 78,128 | 103,895 | 104,588 | 83,718 | 40,414 | 36,371 | 494,251 |
| Oct 1985 | 4,501 | 9,749 | 32,525 | 77,850 | 102,567 | 101,910 | 85,410 | 40,250 | 37,530 | 492,292 |
| Nov 1985 | 4,521 | 9,788 | 32,555 | 78,087 | 101,686 | 100,350 | 88,260 | 40,251 | 37,436 | 492,934 |
| Dec 1985 | 4,567 | 9,883 | 32,587 | 78,753 | 101,197 | 99,494 | 90,006 | 40,578 | 37,142 | 494,207 |
| Jan 1986 | 4,559 | 9,818 | 32,512 | 78,490 | 101,543 | 99,567 | 89,857 | 41,826 | 36,574 | 494,746 |
| Feb 1986 | 4,578 | 9,870 | 32,549 | 78,453 | 102,174 | 100,157 | 89,149 | 42,576 | 36,339 | 495,845 |
| Mar 1986 | 4,619 | 9,953 | 32,418 | 78,728 | 102,951 | 101,457 | 87,954 | 43,540 | 34,620 | 496,240 |
| Apr 1986 | 4,659 | 10,066 | 32,259 | 78,508 | 103,695 | 102,672 | 87,058 | 43,834 | 33,042 | 495,793 |
| May 1986 | 4,671 | 10,087 | 32,073 | 78,145 | 104,127 | 103,713 | 86,609 | 44,101 | 30,228 | 493,754 |

**Table A-2.** (Continued)

| Month | E-9 | E-8 | E-7 | E-6 | E-5 | E-4 | E-3 | E-2 | E-1 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Jun 1986 | 4,676 | 10,149 | 31,941 | 79,211 | 104,474 | 103,850 | 84,041 | 44,122 | 31,950 | 494,414 |
| Jul 1986 | 4,704 | 10,091 | 31,994 | 79,252 | 103,431 | 104,835 | 84,275 | 43,508 | 34,697 | 496,787 |
| Aug 1986 | 4,753 | 10,031 | 32,634 | 78,805 | 102,465 | 105,983 | 84,032 | 43,181 | 38,029 | 499,913 |
| Sep 1986 | 4,807 | 10,009 | 33,311 | 78,930 | 102,193 | 107,668 | 83,871 | 42,462 | 39,943 | 503,194 |
| Oct 1986 | 4,747 | 9,962 | 33,246 | 78,724 | 103,112 | 106,480 | 84,397 | 42,055 | 40,086 | 502,809 |
| Nov 1986 | 4,757 | 10,010 | 33,357 | 78,798 | 104,195 | 105,514 | 84,017 | 42,046 | 41,536 | 504,230 |
| Dec 1986 | 4,795 | 10,034 | 33,428 | 79,109 | 105,582 | 105,427 | 84,427 | 42,043 | 40,451 | 505,296 |
| Jan 1987 | 4,716 | 9,933 | 33,561 | 78,490 | 104,819 | 103,957 | 86,567 | 43,452 | 39,622 | 505,117 |
| Feb 1987 | 4,670 | 9,875 | 33,856 | 77,967 | 104,248 | 103,383 | 89,519 | 44,877 | 37,576 | 505,971 |
| Mar 1987 | 4,627 | 9,815 | 33,717 | 77,697 | 103,652 | 102,953 | 92,791 | 47,220 | 33,136 | 505,608 |
| Apr 1987 | 4,578 | 9,789 | 33,613 | 77,430 | 102,869 | 102,332 | 95,129 | 47,995 | 31,213 | 504,948 |
| May 1987 | 4,546 | 9,798 | 33,636 | 77,092 | 101,851 | 101,100 | 96,387 | 48,471 | 30,124 | 503,005 |
| Jun 1987 | 4,676 | 10,186 | 32,616 | 81,575 | 104,077 | 105,109 | 84,136 | 48,879 | 31,336 | 502,590 |
| Jul 1987 | 4,593 | 10,087 | 32,460 | 81,069 | 102,724 | 104,648 | 86,254 | 48,055 | 34,441 | 504,331 |
| Aug 1987 | 4,531 | 10,009 | 34,395 | 78,568 | 101,756 | 104,430 | 90,187 | 46,796 | 36,566 | 507,238 |
| Sep 1987 | 4,619 | 10,395 | 33,743 | 80,817 | 102,128 | 107,729 | 86,505 | 45,773 | 37,352 | 509,061 |

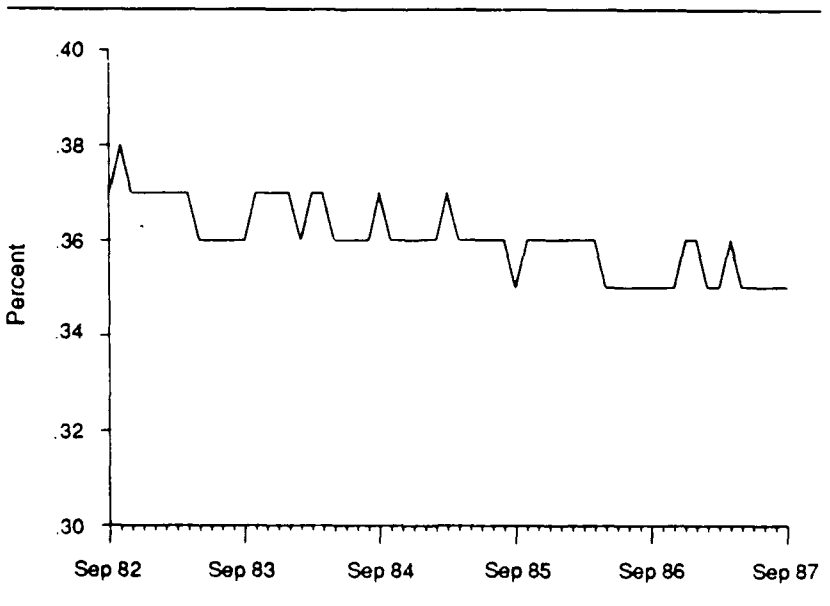


**Figure A-1.** 0-7s to 0-10s as a percentage of officers

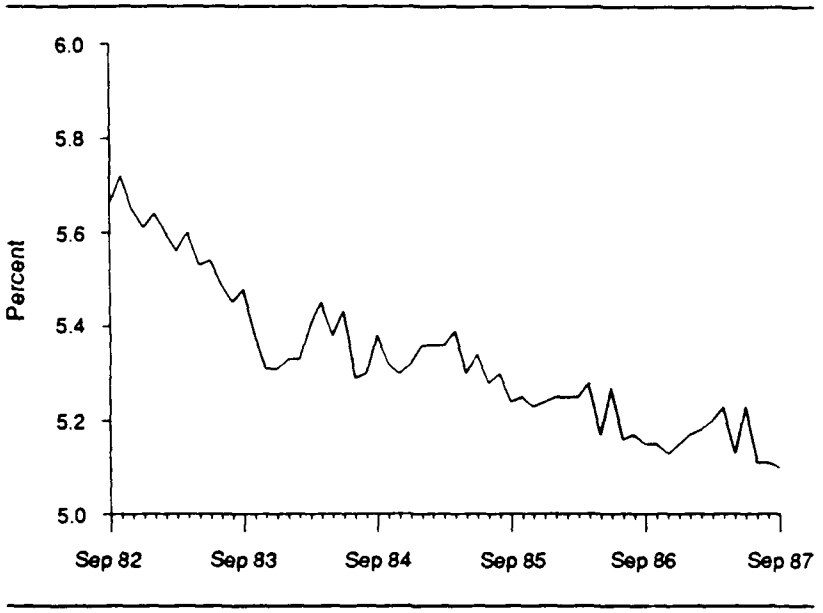


**Figure A-2.** 0-6s as a percentage of officers

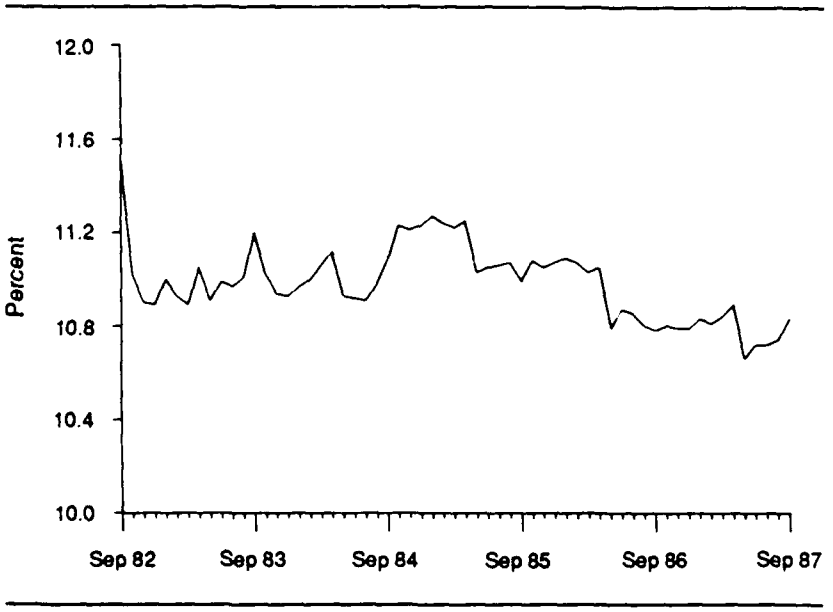


**Figure A-3.** 0-5s as a percentage of officers

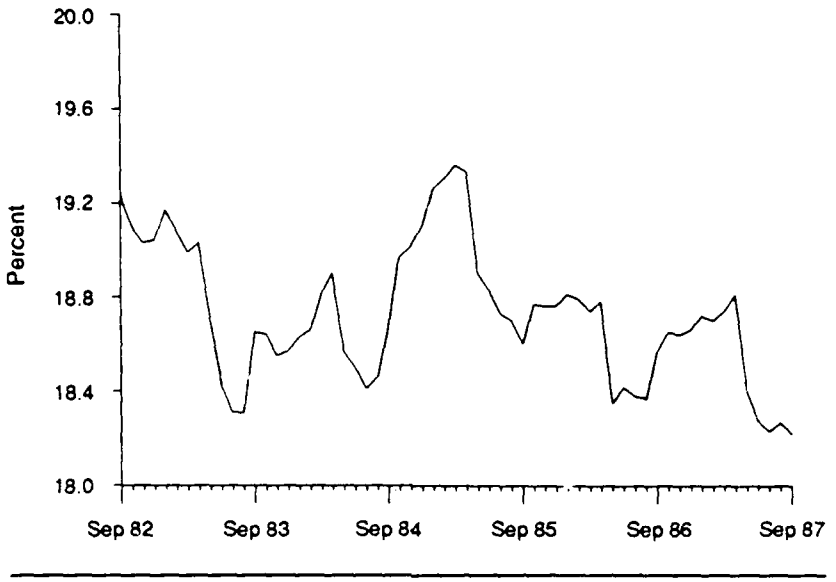


**Figure A-4.** 0-4s as a percentage of officers

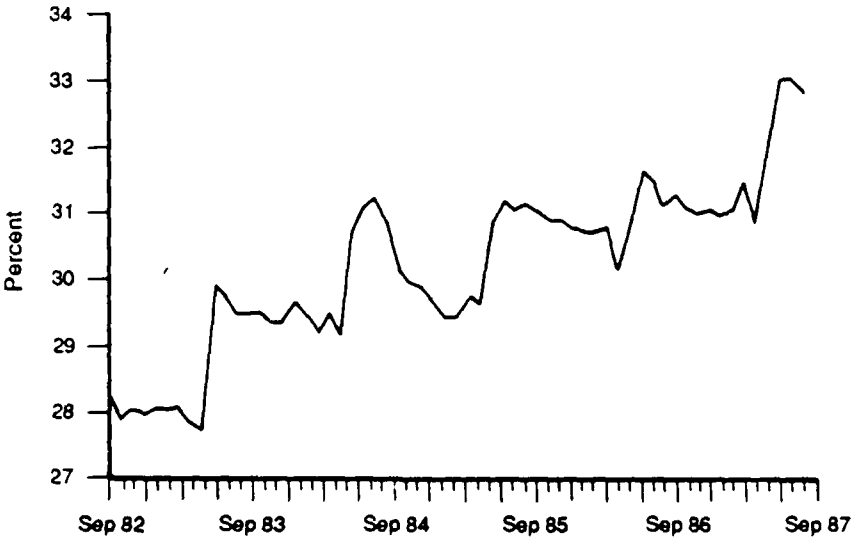


**Figure A-5.** 0-3s as a percentage of officers

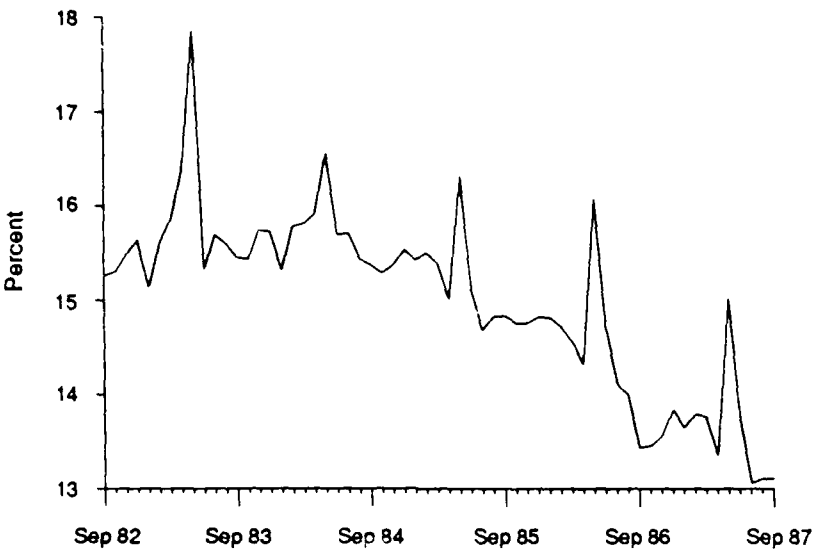


**Figure A-6.** 0-2s as a percentage of officers

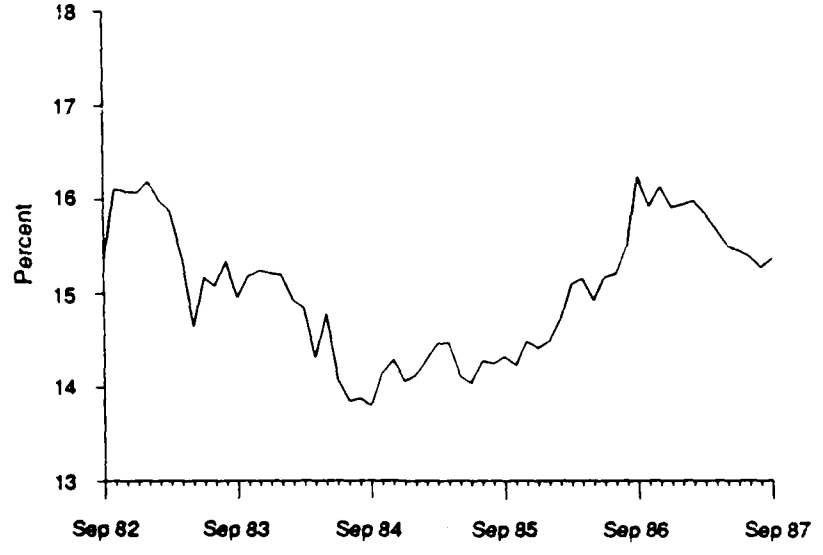


**Figure A-7.** 0-1s as a percentage of officers

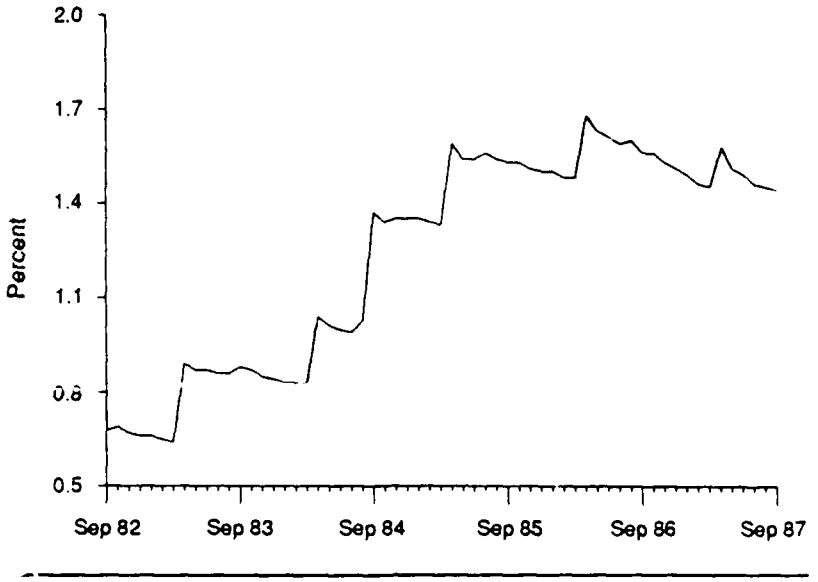


**Figure A-8.** W-4s as a percentage of officers

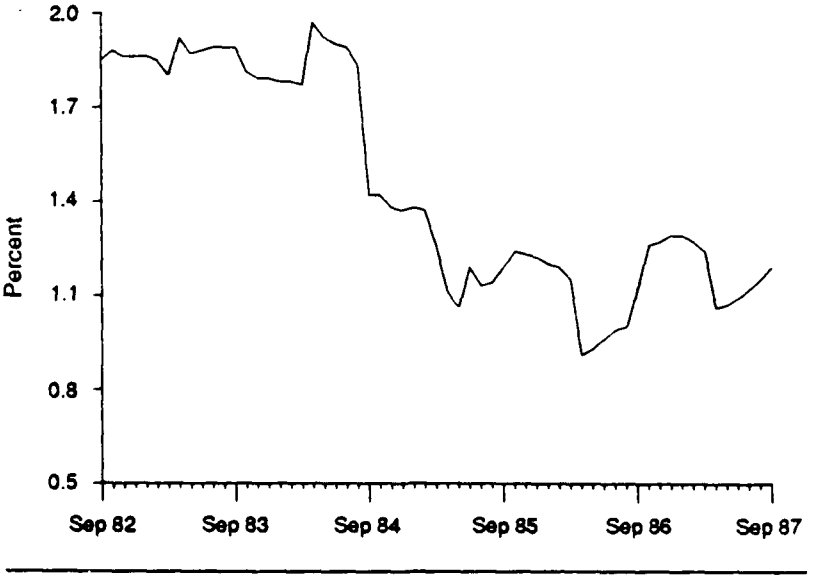


**Figure A-9.** W-3s as a percentage of officers

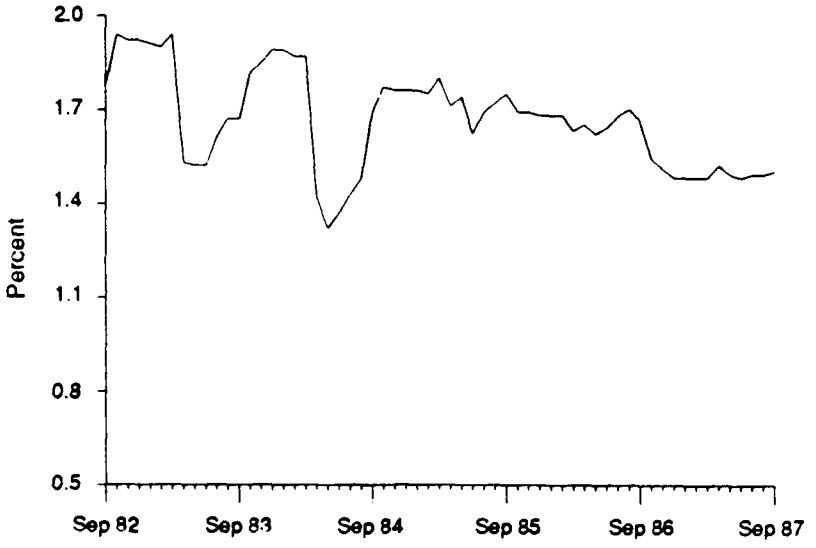


**Figure A-10.** W-2s as a percentage of officers

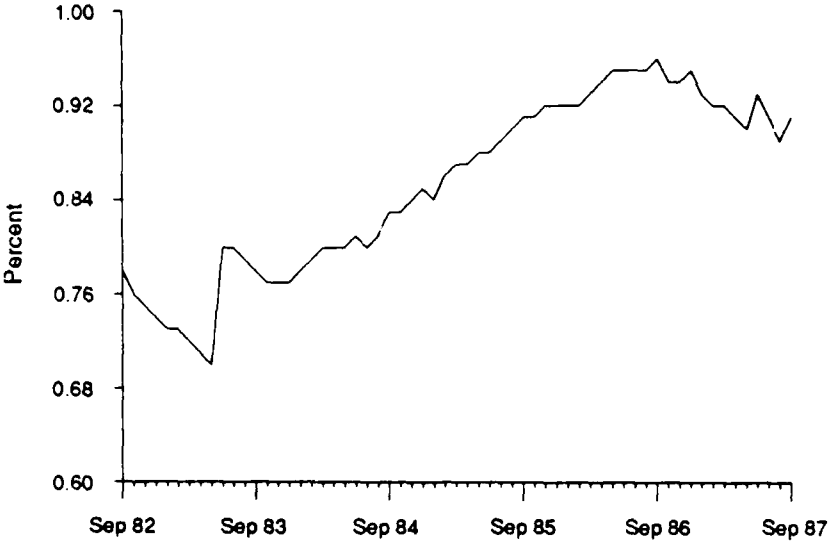


**Figure A-11.** E-9s as a percentage of enlisted

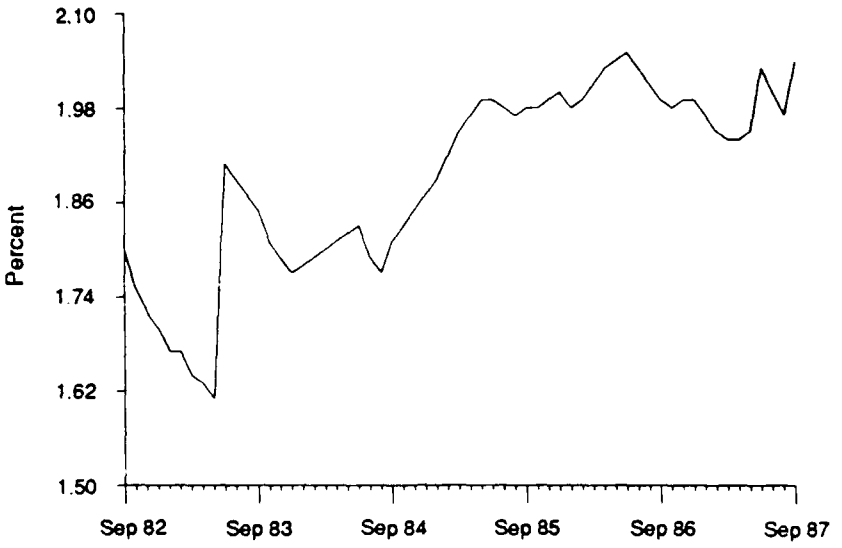


**Figure A-12.** E-8s as a percentage of enlisted

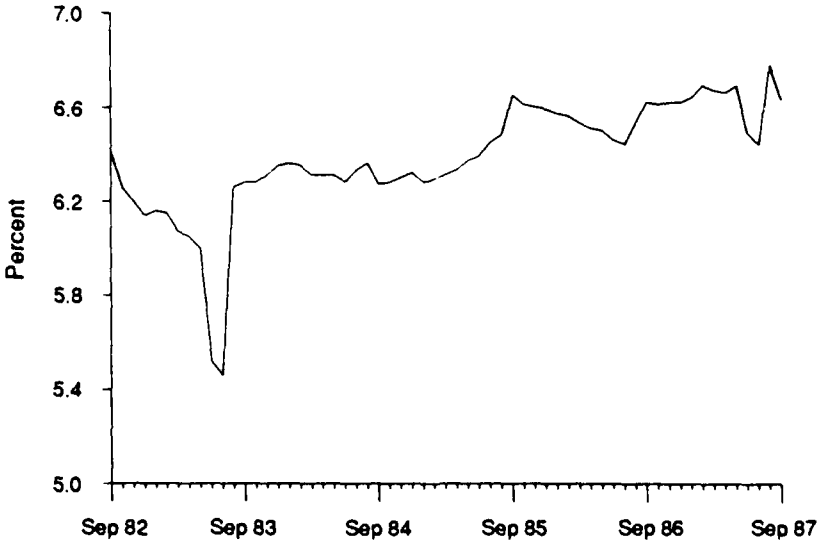


**Figure A-13.** E-7s as a percentage of enlisted

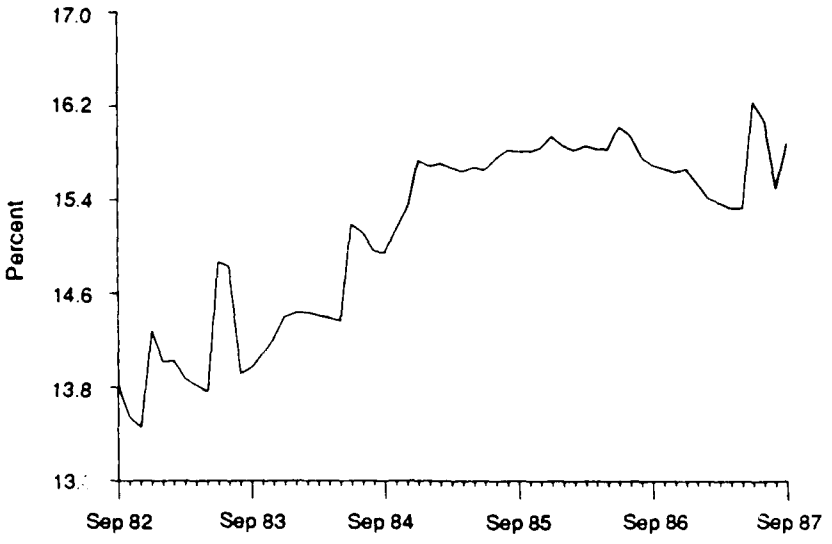


**Figure A-14.** E-6s as a percentage of enlisted

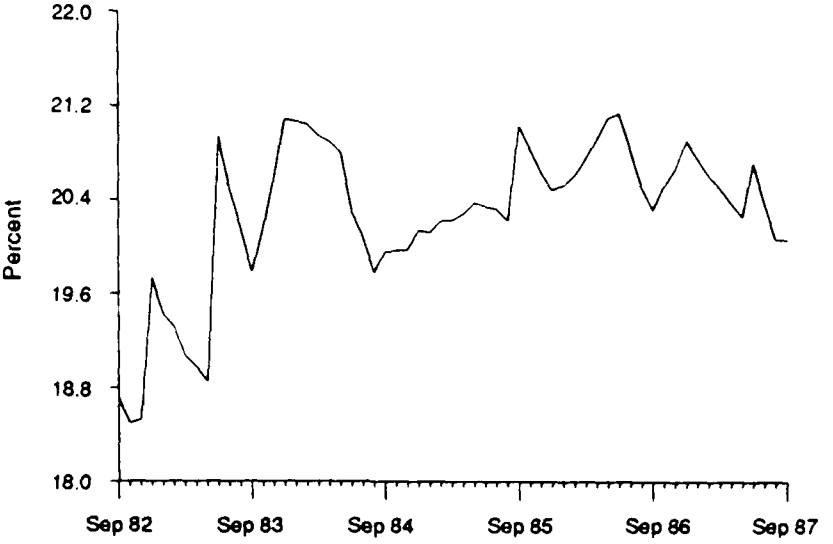


**Figure A-15.** E-5s as a percentage of enlisted

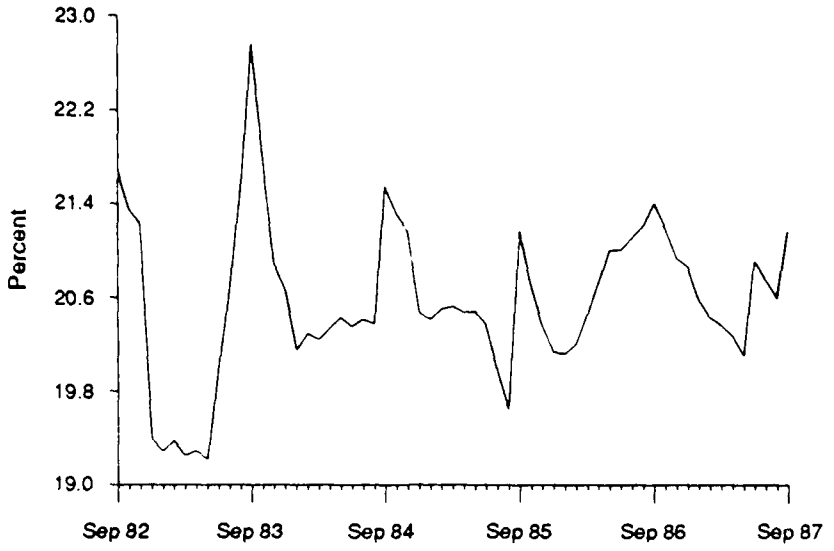


**Figure A-16.** E-4s as a percentage of enlisted

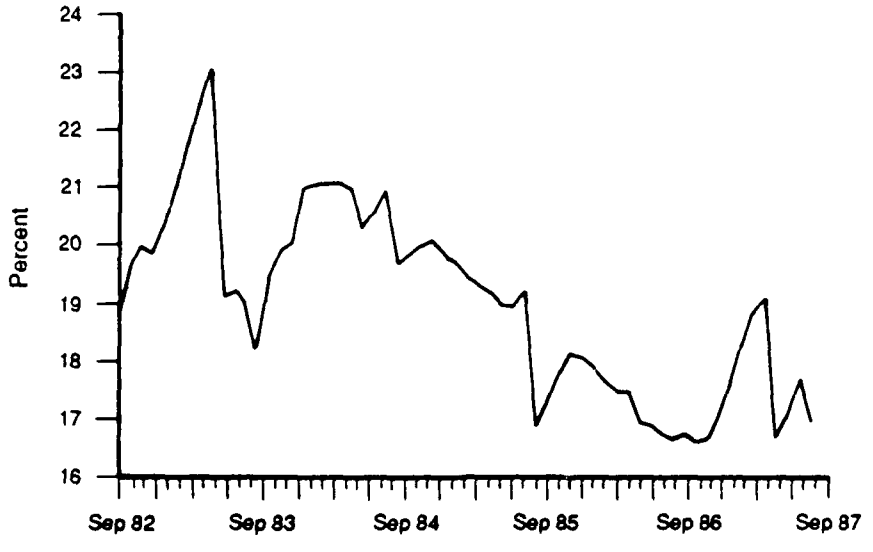


**Figure A-17.** E-3s as a percentage of enlisted

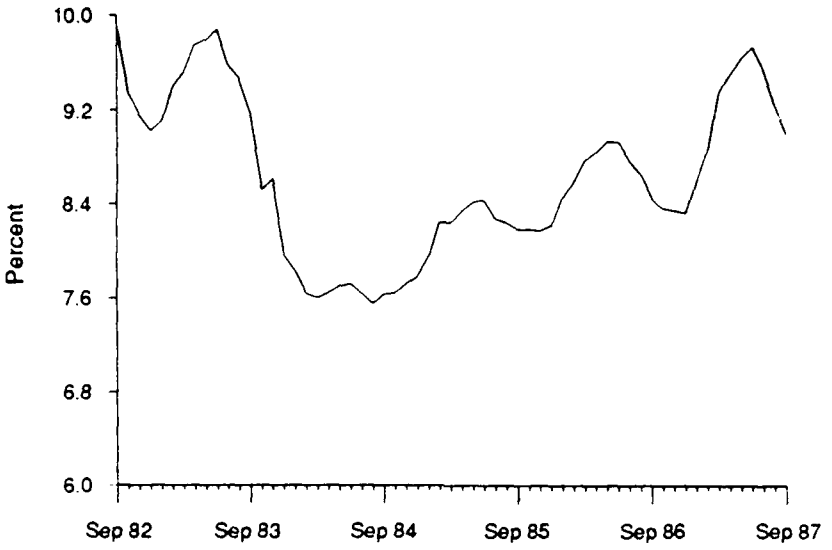


**Figure A-18.** E-2s as a percentage of enlisted

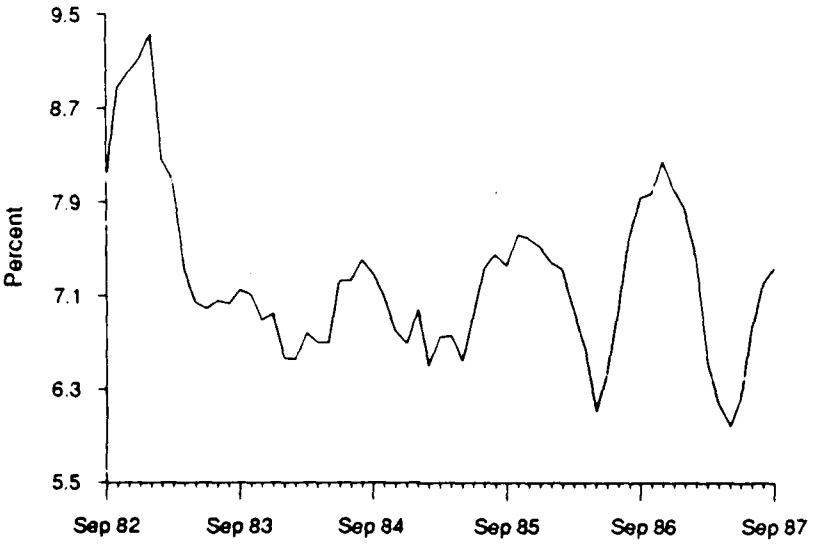


**Figure A-19.** E-1s as a percentage of enlisted

# APPENDIX B

# OBLIGATION DATA

# APPENDIX B

## OBLIGATION DATA

The following data are monthly MPN obligations for FY 1983 to FY 1987 as reported on NAVCOMPT Form 2158 (Revision 5-74). The data were obtained from NMPC-7.

**Table B-1.** Monthly officer MPN obligations (in thousands of dollars)

| | Basic pay | RPA | Incentive pay | Special pay | BAQ | VHA | BAS | Overseas station | Uniform allowance | Family separation | Separation payments | FICA | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct 1982 | 145,027 | | 11,082 | 10,199 | 20,774 | 7,784 | 6,602 | 1,401 | 259 | 160 | 1,582 | 8,739 | 287,138 |
| Nov 1982 | 139,268 | | 7,940 | 5,140 | 20,136 | 6,116 | 6,498 | 1,801 | 139 | 189 | 1,529 | 8,260 | 267,625 |
| Dec 1982 | 146,146 | | 6,978 | 2,565 | 20,392 | 7,323 | 6,574 | 898 | 54 | 120 | 3,889 | 7,001 | 276,036 |
| Jan 1983 | 140,960 | | 6,782 | 4,823 | 21,082 | 5,819 | 6,603 | 2,676 | 73 | 122 | 53 | 10,337 | 270,797 |
| Feb 1983 | 139,296 | | 5,124 | 7,105 | 20,472 | 5,933 | 6,605 | 982 | 99 | 197 | 3,001 | 9,660 | 269,097 |
| Mar 1983 | 142,800 | | 5,912 | 5,187 | 20,665 | 6,109 | 6,655 | 1,372 | 84 | 138 | 639 | 9,702 | 271,663 |
| Apr 1983 | 144,419 | | 7,483 | 6,162 | 20,733 | 6,537 | 6,553 | 2,060 | 117 | 207 | 548 | 9,694 | 277,733 |
| May 1983 | 144 448 | | 9,297 | 5,561 | 21,928 | 7,186 | 6,629 | 1,706 | 739 | 193 | -322 | 9,493 | 280,093 |
| Jun 1983 | 148,795 | | 2,789 | 8,691 | 21,778 | 6,753 | 6,876 | 3,219 | 504 | 145 | 4,053 | 10,016 | 289,058 |
| Jul 1983 | 147,115 | | 19,147 | 27,437 | 21,716 | 6,933 | 6,747 | 1,558 | -389 | 182 | 1,943 | 10,353 | 317,329 |
| Aug 1983 | 149,724 | | 10,302 | 7,629 | 21,744 | 6,852 | 6,822 | 2,275 | 78 | 160 | 2,982 | 9,851 | 294,329 |
| Sep 1983 | 146,046 | | 10,033 | 14,461 | 19,999 | 7,079 | 6,697 | 794 | 66 | 176 | 2,226 | 9,921 | 291,543 |
| Oct 1983 | 146,669 | | 10,163 | 10,078 | 21,317 | 6,751 | 6,772 | 1,698 | 173 | 165 | 1,948 | 9,245 | 289,780 |
| Nov 1983 | 148,151 | | 6,367 | 5,625 | 21,523 | 6,901 | 6,819 | 2,494 | 371 | 165 | 1,501 | 9,036 | 284,510 |
| Dec 1983 | 146,094 | | 6,790 | 5,140 | 21,400 | 6,614 | 6,765 | 1,913 | 56 | 161 | 2,977 | 8,350 | 280,768 |
| Jan 1984 | 152,665 | | 9,946 | 6,176 | 22,115 | 6,073 | 7,009 | 1,780 | -116 | 148 | 3,072 | 10,759 | 297,486 |
| Feb 1984 | 152,135 | | 7,560 | 5,781 | 22,027 | 6,108 | 7,030 | 1,621 | 95 | 160 | -1,152 | 10,661 | 289,685 |
| Mar 1984 | 148,058 | | 8,843 | 4,590 | 21,803 | 6,464 | 6,938 | 1,791 | 45 | 225 | 1,266 | 10,675 | 286,208 |
| Apr 1984 | 153,588 | | 5,333 | 5,076 | 22,210 | 5,928 | 7,034 | 2,007 | 70 | 158 | 1,890 | 10,825 | 292,349 |
| May 1984 | 156,888 | | 7,144 | 6,335 | 23,249 | 6,577 | 6,965 | 1,863 | 374 | 159 | 1,373 | 13,719 | 304,659 |
| Jun 1984 | 160,747 | | 8,630 | 9,750 | 23,007 | 6,318 | 8,189 | 2,289 | 177 | 87 | 2,986 | 9,135 | 313,296 |
| Jul 1984 | 158,820 | | 12,760 | 27,364 | 21,792 | 4,965 | 5,996 | 2,051 | 169 | 233 | 3,991 | 10,285 | 329,424 |
| Aug 1984 | 160,579 | | 10,284 | 6,527 | 25,603 | 6,974 | 8,086 | 2,057 | 58 | 98 | 2,765 | 11,554 | 316,482 |
| Sep 1984 | 142,074 | | 9,691 | 18,138 | 19,550 | 5,184 | 6,069 | 2,329 | 40 | 182 | 3,278 | 10,360 | 289,353 |
| Oct 1984 | 154,054 | 78,827 | 8,929 | 10,697 | 22,542 | 6,068 | 7,077 | 1,908 | 262 | 151 | 2,611 | 10,181 | 303,307 |
| Nov 1984 | 153,442 | 78,823 | 7,175 | 5,292 | 22,420 | 6,108 | 6,872 | 1,988 | 167 | 141 | 2,055 | 9,994 | 294,477 |
| Dec 1984 | 153,299 | 79,063 | 6,504 | 4,613 | 22,458 | 6,055 | 7,120 | 2,028 | -34 | 203 | 1,942 | 9,399 | 292,650 |
| Jan 1985 | 159,952 | 81,686 | 8,167 | 6,138 | 23,097 | 8,749 | 7,243 | 2,220 | 89 | 213 | 5,292 | 11,407 | 314,253 |
| Feb 1985 | 158,274 | 81,733 | 6,926 | 5,275 | 23,289 | 8,694 | 7,455 | 2,160 | 136 | 43 | 2,718 | 11,365 | 308,068 |
| Mar 1985 | 157,982 | 81,691 | 8,688 | 5,575 | 22,747 | 8,949 | 7,271 | 1,910 | 120 | 240 | -296 | 11,382 | 306,259 |
| Apr 1985 | 164,942 | 84,090 | 9,068 | 5,473 | 23,681 | 8,913 | 7,544 | 2,097 | 97 | 140 | 2,802 | 11,964 | 320,811 |
| May 1985 | 160,352 | 82,360 | 7,046 | 5,287 | 22,084 | 7,907 | 7,147 | 1,761 | 465 | 148 | 120 | 10,917 | 305,594 |
| Jun 1985 | 167,743 | 86,129 | 7,189 | 8,790 | 23,749 | 8,914 | 7,483 | 2,291 | 227 | 166 | 1,762 | 11,748 | 326,191 |
| Jul 1985 | 163,296 | 83,944 | 8,291 | 28,424 | 24,554 | 8,664 | 7,474 | 2,132 | 164 | 113 | 6,049 | 11,675 | 344,780 |
| Aug 1985 | 161,303 | 83,549 | 8,586 | 8,404 | 24,083 | 9,182 | 7,514 | 2,519 | 129 | 141 | 1,944 | 11,595 | 318,949 |
| Sep 1985 | 162,159 | 75,100 | 8,614 | 17,456 | 23,479 | 9,074 | 7,491 | 2,138 | 237 | 158 | 3,338 | 11,487 | 320,731 |
| Oct 1985 | 162,694 | 83,039 | 7,330 | 9,709 | 23,541 | 8,988 | 7,511 | 2,368 | 93 | 214 | 2,139 | 11,145 | 318,771 |
| Nov 1985 | 173,024 | 87,627 | 5,572 | 4,535 | 24,821 | 10,035 | 7,911 | 2,172 | 166 | 571 | 3,157 | 11,213 | 330,804 |
| Dec 1985 | 171,887 | 87,396 | 6,887 | 5,856 | 24,292 | 9,413 | 7,693 | 2,325 | 26 | 24 | 3,476 | 10,347 | 329,622 |
| Jan 1986 | 169,727 | 86,376 | 8,048 | 7,058 | 24,516 | 9,521 | 7,717 | 2,237 | 133 | 308 | 2,028 | 12,112 | 329,781 |
| Feb 1986 | 163,785 | 84,137 | 7,730 | 3,907 | 24,222 | 9,683 | 7,699 | 2,875 | 146 | 91 | 1,059 | 12,129 | 317,463 |
| Mar 1986 | 166,592 | 83,930 | 8,109 | 10,083 | 24,740 | 9,481 | 7,678 | 2,597 | 199 | 402 | 1,166 | 12,099 | 327,076 |
| Apr 1986 | 173,331 | 88,112 | 8,614 | 5,585 | 24,367 | 8,869 | 7,724 | 2,623 | -20 | 294 | 1,253 | 12,147 | 332,899 |
| May 1986 | 168,924 | 86,007 | 7,108 | 6,401 | 24,521 | 8,971 | 7,768 | 2,727 | 540 | 234 | 1,042 | 12,240 | 326,483 |
| Jun 1986 | 166,233 | 85,332 | 6,801 | 8,736 | 25,266 | 9,362 | 7,972 | 3,127 | 353 | 302 | 2,313 | 12,488 | 328,285 |
| Jul 1986 | 172,352 | 86,744 | 9,214 | 28,987 | 25,007 | 9,644 | 7,921 | 3,329 | 71 | 461 | 6,271 | 12,430 | 361,431 |
| Aug 1986 | 171,826 | 71,227 | 6,995 | 7,958 | 24,949 | 9,473 | 7,932 | 3,291 | 112 | 296 | 868 | 12,326 | 317,253 |
| Sep 1986 | 168,987 | 71,702 | 6,997 | 14,958 | 24,968 | 9,468 | 7,897 | 3,134 | 167 | 264 | 3,454 | 12,293 | 324,269 |
| Oct 1986 | 171,761 | 89,885 | 7,059 | 8,937 | 24,922 | 9,435 | 8,121 | 3,067 | 167 | 300 | 1,694 | 12,283 | 337,631 |
| Nov 1986 | 170,841 | 89,359 | 6,831 | 6,137 | 24,835 | 9,454 | 7,883 | 3,393 | 90 | 364 | 5,410 | 11,438 | 336,035 |
| Dec 1986 | 169,699 | 89,405 | 7,333 | 7,457 | 24,692 | 9,257 | 7,860 | 2,276 | 54 | 293 | 2,437 | 11,072 | 331,835 |
| Jan 1987 | 174,838 | 91,231 | 7,156 | 7,717 | 25,621 | 9,560 | 8,050 | 3,176 | 180 | 194 | 3,342 | 12,518 | 343,583 |
| Feb 1987 | 175,854 | 92,190 | 7,860 | 7,264 | 26,013 | 10,154 | 7,870 | 1,649 | 181 | -390 | 614 | 12,466 | 341,725 |
| Mar 1987 | 174,935 | 91,495 | 7,674 | 9,502 | 25,611 | 10,242 | 8,089 | 3,552 | 150 | 292 | 1,123 | 12,688 | 345,353 |
| Apr 1987 | 173,606 | 91,414 | 8,463 | 7,106 | 25,628 | 9,844 | 8,037 | 3,203 | 102 | 259 | 2,256 | 12,835 | 342,553 |
| May 1987 | 176,234 | 92,112 | 10,522 | 7,198 | 25,897 | 9,904 | 8,147 | 3,772 | 476 | 272 | 1,638 | 12,592 | 348,764 |
| Jun 1987 | 179,823 | 94,076 | 9,271 | 8,559 | 25,855 | 10,063 | 8,223 | 4,922 | 230 | 327 | 1,947 | 12,935 | 356,231 |
| Jul 1987 | 175,516 | 94,188 | 6,218 | 27,432 | 26,271 | 10,079 | 8,225 | 4,115 | 33 | 719 | 3,157 | 12,903 | 368,856 |
| Aug 1987 | 176,684 | 92,873 | 7,454 | 9,363 | 25,476 | 9,727 | 8,216 | 3,475 | 106 | 279 | 2,579 | 12,891 | 349,123 |
| Sep 1987 | 177,927 | 91,122 | 9,367 | 10,900 | 26,243 | 9,932 | 8,053 | 2,434 | 8 | 591 | 5,819 | 12,304 | 354,500 |

**Table B-2.** Monthly enlisted MPN obligations (in thousands of dollars)

| | Basic pay | RPA | Incentive pay | Special pay | Special duty | SRB | Enlistment bonus | BAQ | VHA | Overseas station | Clothing allowance | Family separation | Separation payments | FICA | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Oct 1982 | 412,888 | | 6,291 | 15,982 | 1,658 | 35,864 | 1,367 | 52,395 | 18,563 | 5,649 | 8,095 | 879 | 6,893 | 27,799 | 803,356 |
| Nov 1982 | 420,791 | | 6,502 | 15,928 | 1,637 | 11,024 | 1,353 | 57,260 | 19,269 | 5,407 | 8,422 | 1,273 | 6,080 | 28,483 | 796,770 |
| Dec 1982 | 422,959 | | 6,189 | 16,020 | 1,669 | 1,274 | 867 | 54,779 | 19,326 | 6,076 | 8,617 | 711 | 4,498 | 28,153 | 785,578 |
| Jan 1983 | 424,800 | | 5,836 | 19,801 | 1,994 | 17,117 | 799 | 56,787 | 19,502 | 6,062 | 7,592 | 928 | 4,745 | 28,845 | 809,982 |
| Feb 1983 | 422,995 | | 6,146 | 19,695 | 1,733 | 4,320 | 1,152 | 56,597 | 19,374 | 6,083 | 7,796 | 1,295 | 5,241 | 28,376 | 795,261 |
| Mar 1983 | 421,928 | | 5,142 | 18,555 | 1,795 | 20,600 | 2,422 | 56,327 | 19,054 | 8,629 | 7,592 | 861 | 5,204 | 28,312 | 810,338 |
| Apr 1983 | 427,887 | | 6,427 | 17,493 | 1,850 | 12,016 | 639 | 56,662 | 19,014 | 6,523 | 7,305 | 1,284 | 5,967 | 28,980 | 808,986 |
| May 1983 | 431,718 | | 6,358 | 17,648 | 1,852 | 12,403 | 74 | 56,866 | 19,885 | 7,513 | 7,721 | 1,169 | 5,185 | 28,897 | 815,970 |
| Jun 1983 | 421,710 | | 6,593 | 18,981 | 1,999 | 15,376 | 665 | 56,326 | 19,661 | 6,351 | 7,348 | 1,340 | 5,237 | 28,230 | 803,506 |
| Jul 1983 | 429,958 | | 6,628 | 17,312 | 1,912 | 13,496 | 640 | 59,331 | 20,612 | 6,217 | 7,640 | 868 | 6,404 | 28,887 | 817,894 |
| Aug 1983 | 422,577 | | 6,229 | 19,180 | 1,998 | 6,361 | -466 | 57,355 | 19,732 | 7,168 | 8,929 | 1,041 | 6,492 | 28,710 | 799,553 |
| Sep 1983 | 440,868 | | 6,435 | 20,695 | 1,886 | 12,642 | 1,128 | 57,682 | 20,066 | 6,404 | 8,641 | 1,085 | 5,292 | 29,844 | 835,988 |
| Oct 1983 | 429,593 | | 6,554 | 18,412 | 1,744 | 14,900 | 640 | 58,717 | 20,205 | 6,806 | 7,773 | 1,098 | 6,886 | 28,921 | 821,341 |
| Nov 1983 | 425,751 | | 6,399 | 19,659 | 1,867 | 18,911 | 1,136 | 57,515 | 20,501 | 7,121 | 8,121 | 1,171 | 5,632 | 8,647 | 819,564 |
| Dec 1983 | 432,538 | | 6,419 | 18,337 | 1,767 | 11,934 | 1,140 | 59,868 | 20,429 | 7,140 | 8,018 | 1,304 | 5,583 | 29,000 | 823,901 |
| Jan 1984 | 448,243 | | 6,253 | 19,873 | 1,940 | 17,833 | 566 | 62,088 | 18,743 | 6,419 | 8,849 | 813 | 5,581 | 31,377 | 857,171 |
| Feb 1984 | 447,725 | | 6,295 | 19,085 | 2,032 | 17,699 | 1,302 | 61,305 | 18,289 | 6,683 | 8,279 | 726 | 5,362 | 31,635 | 854,739 |
| Mar 1984 | 445,345 | | 6,844 | 18,910 | 1,728 | 14,579 | 6,327 | 60,721 | 17,415 | 7,697 | 9,052 | 1,294 | 6,231 | 30,943 | 854,212 |
| Apr 1984 | 450,534 | | 7,026 | 20,302 | 2,024 | 17,455 | -4,551 | 62,252 | 20,736 | 8,133 | 8,223 | 1,182 | 2,567 | 31,627 | 857,282 |
| May 1984 | 454,834 | | 6,908 | 21,021 | 2,330 | 17,134 | 4,232 | 61,972 | 19,159 | 7,002 | 8,764 | 1,167 | 5,745 | 31,936 | 874,169 |
| Jun 1984 | 454,378 | | 6,240 | 18,969 | 1,450 | 15,976 | -2 537 | 62,570 | 18,012 | 7,239 | 9,485 | 1,142 | 6,662 | 32,568 | 863,867 |
| Jul 1984 | 461,660 | | 5,579 | 19,348 | 1,953 | 6,897 | 1,110 | 62,172 | 18,530 | 6,851 | 8,884 | 1,121 | 4,515 | 31,925 | 865,992 |
| Aug 1984 | 456,647 | | 6,049 | 20,632 | 2,320 | 15,398 | 1,110 | 62,640 | 19,067 | 6,406 | 8,632 | 1,159 | 8,217 | 31,420 | 875,607 |
| Sep 1984 | 444,598 | | 6,681 | 19,781 | 1,629 | 14,229 | 636 | 63,798 | 19,401 | 7,368 | 7,726 | 1,090 | 6,358 | 33,032 | 853,072 |
| Oct 1984 | 456,952 | 232,690 | 6,741 | 19,867 | 1,870 | 34,587 | 925 | 62,575 | 18,975 | 8,245 | 9,036 | 1,217 | 8,611 | 32,127 | 892,418 |
| Nov 1984 | 451,864 | 230,232 | 5,991 | 19,249 | 1,929 | 15,079 | 925 | 63,802 | 18,957 | 6,168 | 8,743 | 561 | 5,062 | 31,779 | 860,341 |
| Dec 1984 | 452,599 | 230,786 | 6,432 | 19,491 | 2,141 | 22,059 | 925 | 63,302 | 20,349 | 7,265 | 7,081 | 1,542 | 4,926 | 31,517 | 870,437 |
| Jan 1985 | 478,800 | 244,031 | 6,621 | 19,291 | 1,900 | 16,091 | 925 | 67,302 | 24,803 | 8,405 | 8,876 | 1,138 | 6,073 | 34,287 | 918,543 |
| Feb 1985 | 475,578 | 242,806 | 6,253 | 20,848 | 2,079 | 13,798 | 925 | 67,509 | 25,101 | 6,947 | 8,850 | 880 | 7,678 | 33,159 | 912,391 |
| Mar 1985 | 477,095 | 244,474 | 6,498 | 21,410 | 2,181 | 18,422 | 925 | 68,189 | 24,336 | 4,767 | 7,487 | 1,359 | 5,687 | 34,032 | 916,859 |
| Apr 1985 | 489,232 | 247,744 | 7,166 | 18,866 | 2,372 | 14,974 | 925 | 68,437 | 24,277 | 6,899 | 10,005 | 1,034 | 5,509 | 34,491 | 931,731 |
| May 1985 | 483,116 | 245,625 | 6,059 | 20,669 | 3,057 | 14,900 | 925 | 68,420 | 24,206 | 6,681 | 8,685 | 1,347 | 151 | 33,777 | 917,620 |
| Jun 1985 | 476,915 | 243,089 | 6,746 | 19,902 | 2,905 | 16,566 | 925 | 68,261 | 24,878 | 5,623 | 8,577 | 1,014 | 7,300 | 33,639 | 916,340 |
| Jul 1985 | 481,044 | 245,065 | 6,748 | 19,798 | 3,118 | 16,986 | 925 | 68,621 | 23,136 | 6,263 | 9,767 | 542 | 5,559 | 34,163 | 921,734 |
| Aug 1985 | 475,740 | 242,942 | 7,333 | 20,026 | 2,510 | 14,436 | 925 | 67,651 | 23,124 | 7,389 | 9,467 | 1,361 | 9,413 | 33,790 | 916,109 |
| Sep 1985 | 481,258 | 238,920 | 7,178 | 20,161 | 2,932 | 20,056 | 925 | 67,743 | 24,462 | 7,121 | 10,427 | 1,083 | 6,331 | 33,981 | 920,577 |
| Oct 1985 | 482,530 | 245,338 | 7,046 | 19,680 | 2,818 | 56,556 | 1,008 | 68,530 | 24,937 | 7,276 | 5,146 | 1,310 | 6,272 | 34,207 | 962,653 |
| Nov 1985 | 514,068 | 260,794 | 8,340 | 20,026 | 2,789 | 25,512 | 886 | 72,801 | 27,040 | 6,883 | 8,129 | 3,202 | 4,578 | 36,369 | 989,396 |
| Dec 1985 | 496,440 | 251,986 | 7,427 | 19,412 | 2,996 | 18,261 | 1,736 | 70,924 | 25,518 | 9,445 | 6,783 | 1,500 | 3,981 | 35,121 | 951,489 |
| Jan 1986 | 498,367 | 251,088 | 6,775 | 20,055 | 2,945 | 28,741 | 424 | 69,814 | 23,830 | 8,911 | 3,295 | 1,718 | 7,583 | 35,736 | 957,281 |
| Feb 1986 | 504,203 | 258,162 | 7,871 | 20,407 | 4,422 | 18,278 | 256 | 73,173 | 27,612 | 7,721 | 7,453 | 2,109 | 5,244 | 35,982 | 972,893 |
| Mar 1986 | 496,366 | 251,478 | 7,146 | 20,178 | 4,599 | 22,516 | 642 | 71,475 | 17,924 | 9,015 | 6,379 | 3,030 | 8,534 | 35,379 | 964,661 |
| Apr 1986 | 507,480 | 257,483 | 6,921 | 20,948 | 5,324 | 16,196 | 1,730 | 71,736 | 30,682 | 9,513 | 6,332 | 1,900 | 918 | 36,386 | 973,547 |
| May 1986 | 502,202 | 254,958 | 7,854 | 20,864 | 3,095 | 16,036 | -126 | 72,033 | 24,276 | 10,331 | 5,864 | 2,155 | 7,657 | 37,346 | 964,545 |
| Jun 1986 | 499,275 | 254,951 | 7,801 | 21,233 | 3,612 | 3,548 | 877 | 72,447 | 24,425 | 9,328 | 11,473 | 2,830 | 5,949 | 34,828 | 952,377 |
| Jul 1986 | 498,382 | 253,283 | 7,811 | 20,144 | 4,000 | 16,212 | -185 | 72,134 | 23,273 | 9,925 | 10,834 | 3,137 | 6,341 | 36,174 | 961,445 |
| Aug 1986 | 508,775 | 211,766 | 7,568 | 21,870 | 4,049 | 15,577 | 1,168 | 72,402 | 20,285 | 10,655 | 12,542 | 2,210 | 7,271 | 36,501 | 930,639 |
| Sep 1986 | 503,265 | 211,498 | 8,273 | 22,196 | 4,317 | 18,420 | 547 | 72,381 | 21,994 | 9,754 | 16,153 | 1,376 | 5,477 | 35,564 | 931,215 |
| Oct 1986 | 508,803 | 265,733 | 7,789 | 20,827 | 4,428 | 57,322 | 1,509 | 71,916 | 22,773 | 10,262 | 11,876 | 2,562 | 7,020 | 36,448 | 1,029,258 |
| Nov 1986 | 514,146 | 267,877 | 7,591 | 21,983 | 4,609 | 28,765 | -1,194 | 73,445 | 23,954 | 10,062 | 11,640 | 2,302 | 5,864 | 36,701 | 1,007,525 |
| Dec 1986 | 514,355 | 268,198 | 7,861 | 20,868 | 3,825 | 30,892 | 2,023 | 73,512 | 24,686 | 9,392 | 10,202 | 1,623 | 5,589 | 34,644 | 1,007,670 |
| Jan 1987 | 523,156 | 272,716 | 7,056 | 20,529 | 4,260 | 16,460 | 815 | 75,231 | 24,124 | 9,120 | 14,995 | 1,980 | 4,638 | 37,239 | 1,012,319 |
| Feb 1987 | 524,273 | 273,263 | 7,500 | 22,568 | 4,374 | 21,034 | 298 | 74,142 | 24,031 | 8,987 | 9,804 | 1,928 | 4,556 | 37,305 | 1,014,063 |
| Mar 1987 | 528,161 | 275,334 | 8,356 | 21,106 | 4,694 | 28,324 | 591 | 76,408 | 25,489 | 10,752 | 4,656 | 2,800 | 5,637 | 37,450 | 1,029,758 |
| Apr 1987 | 527,223 | 273,834 | 8,357 | 21,909 | 4,701 | 11,943 | -88 | 76,222 | 25,970 | 10,582 | 9,213 | 1,813 | 6,135 | 37,540 | 1,015,364 |
| May 1987 | 516,955 | 273,953 | 7,006 | 20,803 | 4,211 | 16,079 | 1,162 | 76,040 | 25,276 | 11,424 | 8,881 | 1,997 | 5,901 | 36,913 | 1,006,601 |
| Jun 1987 | 525,290 | 274,396 | 7,993 | 22,038 | 5,157 | 4,883 | -897 | 75,831 | 26,087 | 13,352 | 12,588 | 2,317 | 7,648 | 37,491 | 1,014,153 |
| Jul 1987 | 526,433 | 275,264 | 8,362 | 21,358 | 1,741 | 8,298 | 7681 | 75,664 | 25,412 | 13,201 | 12,473 | 1,648 | 7,023 | 37,254 | 1,021,810 |
| Aug 1987 | 518,564 | 274,571 | 7,371 | 23,422 | 4,384 | 4,700 | 2,100 | 76,403 | 25,563 | 10,473 | 16,160 | 2,338 | 5,927 | 37,045 | 1,009,001 |
| Sep 1987 | 515,456 | 270,192 | 8,133 | 21,306 | 4,676 | 3,949 | -2,500 | 74,013 | 24,810 | 10,132 | 13,918 | 2,765 | 6,236 | 36,481 | 989,566 |

**Table B-3.** Monthly other MPN obligations

| | Cadets/ midshipmen | Enlisted | | | | | |
|---|---|---|---|---|---|---|---|
| | | BAS | SIK | PCS | Other | Total MPN | Reimbursables |
| Oct 1982 | 2,893 | 33,942 | 21,762 | 61,845 | 292 | 1,211,228 | 7,367 |
| Nov 1982 | 2,805 | 33,578 | 20,961 | 43,157 | 317 | 1,165,213 | 6,946 |
| Dec 1982 | 2,873 | 34,883 | 21,066 | 46,561 | 301 | 1,167,298 | 7,089 |
| Jan 1983 | 3,641 | 34,985 | 19,036 | 29,989 | 403 | 1,168,832 | 8,558 |
| Feb 1983 | 2,802 | 31,521 | 20,547 | 34,482 | 311 | 1,154,022 | 7,493 |
| Mar 1983 | 2,890 | 34,839 | 18,410 | 36,756 | 336 | 1,175,232 | 8,678 |
| Apr 1983 | 2,794 | 34,144 | 22,574 | 39,390 | 475 | 1,186,096 | 8,398 |
| May 1983 | 2,513 | 33,839 | 23,110 | 37,086 | 382 | 1,192,993 | 7,136 |
| Jun 1983 | 2,135 | 33,675 | 19,401 | 57,700 | 248 | 1,205,723 | 10,305 |
| Jul 1983 | 2,877 | 34,857 | 18,552 | 39,658 | 441 | 1,231,608 | 8,094 |
| Aug 1983 | 2,824 | 34,839 | 17,226 | 51,261 | 255 | 1,200,287 | 7,057 |
| Sep 1983 | 2,939 | 35,289 | 22,378 | 39,776 | 254 | 1,228,167 | 7,712 |
| Oct 1983 | 2,882 | 34,948 | 21,389 | 73,378 | 401 | 1,244,120 | 7,775 |
| Nov 1983 | 3,422 | 34,645 | 20,806 | 39,161 | 297 | 1,202,405 | 7,413 |
| Dec 1983 | 2,875 | 35,175 | 21,819 | 42,055 | 324 | 1,206,917 | 7,467 |
| Jan 1984 | 2,853 | 36,700 | 17,780 | 43,671 | 264 | 1,255,925 | 6,786 |
| Feb 1984 | 2,780 | 34,365 | 20,693 | 29,881 | 10,081 | 1,242,224 | 8,130 |
| Mar 1984 | 2,799 | 35,866 | 21,710 | 33,535 | 273 | 1,234,603 | 10,326 |
| Apr 1984 | 2,777 | 35,798 | 19,613 | 42,560 | 312 | 1,250,691 | 8,343 |
| May 1984 | 2,630 | 35,707 | 23,153 | 49,864 | 10,145 | 1,300,327 | 7,931 |
| Jun 1984 | 2,102 | 36,666 | 25,612 | 53,985 | 286 | 1,295,814 | 8,759 |
| Jul 1984 | 2,806 | 37,504 | 13,972 | 49,059 | 301 | 1,299,058 | 9,282 |
| Aug 1984 | 2,923 | 36,929 | 24,421 | 32,265 | 19,921 | 1,308,548 | 8,383 |
| Sep 1984 | 2,887 | 43,538 | 26,285 | 28,689 | 276 | 1,244,100 | 8,508 |
| Oct 1984 | 2,889 | 37,376 | 22,264 | 69,697 | 9,004 | 1,344,564 | 7,609 |
| Nov 1984 | 3,409 | 36,837 | 21,668 | 38,678 | 294 | 1,264,231 | 8,527 |
| Dec 1984 | 2,848 | 37,597 | 24,386 | 47,556 | 9,620 | 1,294,430 | 9,336 |
| Jan 1985 | 2,833 | 39,017 | 23,749 | 32,813 | 318 | 1,339,275 | 7,749 |
| Feb 1985 | 2,787 | 36,228 | 19,186 | 38,370 | 309 | 1,328,138 | 10,799 |
| Mar 1985 | 2,805 | 39,834 | 15,655 | 38,606 | 9,532 | 1,342,621 | 13,071 |
| Apr 1985 | 2,785 | 37,216 | 19,209 | 37,948 | 240 | 1,355,102 | 5,162 |
| May 1985 | 2,615 | 39,733 | 20,208 | 49,582 | 1,679 | 1,344,954 | 7,923 |
| Jun 1985 | 2,090 | 37,795 | 22,388 | 59,480 | 9,625 | 1,382,984 | 9,075 |
| Jul 1985 | 2,902 | 39,542 | 20,283 | 49,741 | 281 | 1,388,531 | 9,268 |
| Aug 1985 | 2,959 | 39,716 | 22,614 | 43,764 | 290 | 1,356,104 | 11,703 |
| Sep 1985 | 2,897 | 38,404 | 21,885 | 41,982 | 9,601 | 1,371,417 | 15,340 |
| Oct 1985 | 2,904 | 40,007 | 21,116 | 56,913 | 8,260 | 1,420,500 | 9,876 |
| Nov 1985 | 2,879 | 40,646 | 18,513 | 36,705 | 244 | 1,428,940 | 9,753 |
| Dec 1985 | 3,746 | 40,862 | 18,513 | 38,447 | 6,280 | 1,398,522 | 9,563 |
| Jan 1986 | 2,873 | 41,180 | 22,014 | 39,578 | 341 | 1,402,459 | 9,411 |
| Feb 1986 | 2,828 | 36,931 | 13,778 | 51,780 | 261 | 1,404,627 | 8,693 |
| Mar 1986 | 2,848 | 41,130 | 16,399 | 33,828 | 8,111 | 1,395,781 | 11,728 |
| Apr 1986 | 2,833 | 38,419 | 21,994 | 44,734 | 253 | 1,423,119 | 8,440 |

**Table B-3.** (Continued)

| | Cadets/ midshipmen | Enlisted | | | | | |
|---|---|---|---|---|---|---|---|
| | | BAS | SIK | PCS | Other | Total MPN | Reimbursables |
| May 1986 | 2,640 | 40,401 | 24,623 | 55,361 | 272 | 1,423,521 | 9,196 |
| Jun 1986 | 2,147 | 35,638 | 18,840 | 62,480 | 7,513 | 1,416,500 | 9,220 |
| Jul 1986 | 2,802 | 40,439 | 20,828 | 56,364 | 311 | 1,456,577 | 12,957 |
| Aug 1986 | 2,963 | 49,106 | 20,327 | 51,896 | 313 | 1,379,152 | 6,655 |
| Sep 1986 | 3,046 | 46,755 | 22,863 | 38,269 | 6,101 | 1,386,567 | 14,049 |
| Oct 1986 | 2,944 | 42,717 | 20,198 | 49,607 | 8,911 | 1,500,264 | 8,998 |
| Nov 1986 | 2,986 | 39,069 | 21,759 | 40,182 | 932 | 1,457,920 | 9,432 |
| Dec 1986 | 3,823 | 43,787 | 20,847 | 45,156 | 6,604 | 1,468,106 | 8,384 |
| Jan 1986 | 2,976 | 42,098 | 17,772 | 46,519 | 981 | 1,475,224 | 8,976 |
| Feb 1987 | 2,841 | 40,633 | 20,962 | 37,236 | 940 | 1,467,086 | 8,686 |
| Mar 1987 | 3,017 | 43,337 | 18,593 | 21,171 | 8,731 | 1,479,182 | 9,222 |
| Apr 1987 | 2,965 | 41,868 | 23,685 | 54,531 | 816 | 1,496,032 | 14,250 |
| May 1987 | 2,765 | 43,166 | 20,034 | 47,016 | 909 | 1,481,023 | 11,768 |
| Jun 1987 | 2,286 | 43,067 | 20,108 | 55,097 | 8,167 | 1,506,742 | 7,633 |
| Jul 1987 | 2,815 | 45,249 | 19,727 | 48,871 | 1,122 | 1,520,522 | 12,072 |
| Aug 1987 | 3,625 | 44,372 | 22,461 | 30,000 | 1,042 | 1,474,113 | 14,489 |
| Sep 1987 | 3,350 | 41,669 | 20,605 | 41,534 | 6,190 | 1,467,368 | 9,954 |

# APPENDIX C

# BAQ ENTITLEMENT DISTRIBUTIONS

# APPENDIX C

## BAQ ENTITLEMENT DISTRIBUTIONS

Tables C-1 and C-2 describe the percentages of personnel, on a paygrade-by-paygrade basis, that were receiving BAQ at either the "with dependents" or "without dependents" rates. The data are annual in nature and cover FY 1983 to FY 1987. The data were obtained from NMPC-7.

**Table C-1.** Officer BAQ entitlement distributions (percent)

| | O-7+ | O-6 | O-5 | O-4 | O-3 | O-2 | O-1 | W-4 | W-3 | W-2 |
|---|---|---|---|---|---|---|---|---|---|---|
| FY 1983 | | | | | | | | | | |
| With dependents | 46.8 | 73.3 | 79.0 | 71.8 | 53.4 | 35.7 | 29.1 | 79.0 | 69.2 | 58.7 |
| Without dependents | 1.6 | 3.7 | 6.8 | 11.8 | 27.7 | 39.1 | 48.4 | 3.1 | 1.9 | 1.9 |
| FY 1984 | | | | | | | | | | |
| With dependents | 48.4 | 72.8 | 79.6 | 70.4 | 52.4 | 37.2 | 26.5 | 77.3 | 71.4 | 69.9 |
| Without dependents | 1.6 | 4.9 | 6.7 | 12.8 | 28.0 | 38.4 | 51.6 | 2.7 | 1.8 | 2.1 |
| FY 1985 | | | | | | | | | | |
| With dependents | 46.0 | 72.0 | 79.8 | 69.0 | 52.4 | 36.9 | 24.1 | 76.3 | 73.8 | 68.0 |
| Without dependents | 3.2 | 4.9 | 6.9 | 13.4 | 28.9 | 39.9 | 52.6 | 3.1 | 2.1 | 2.1 |
| FY 1986 | | | | | | | | | | |
| With dependents | 43.3 | 71.3 | 79.7 | 68.8 | 52.7 | 35.8 | 24.0 | 75.7 | 88.6 | 70.8 |
| Without dependents | 2.4 | 5.0 | 7.3 | 14.2 | 29.3 | 43.9 | 56.4 | 3.2 | 2.3 | 2.1 |
| FY 1987 | | | | | | | | | | |
| With dependents | 44.1 | 71.7 | 79.9 | 68.3 | 52.6 | 36.3 | 22.2 | 76.9 | 72.1 | 70.4 |
| Without dependents | 1.6 | 4.8 | 7.5 | 14.4 | 29.0 | 47.2 | 56.8 | 2.7 | 2.3 | 2.1 |

**Table C-2.** Enlisted BAQ entitlement distributions (percent)

| | E-9 | E-8 | E-7 | E-6 | E-5 | E-4 | E-3 | E-2 | E-1 |
|---|---|---|---|---|---|---|---|---|---|
| FY 1983 | | | | | | | | | |
| With dependents | 79.8 | 72.4 | 65.5 | 59.4 | 43.1 | 29.2 | 21.4 | 15.0 | 9.3 |
| Without dependents | 2.1 | 2.8 | 4.0 | 7.2 | 16.1 | 15.1 | 11.1 | 3.9 | 0.6 |
| FY 1984 | | | | | | | | | |
| With dependents | 79.5 | 74.0 | 66.9 | 59.3 | 43.9 | 30.6 | 22.1 | 15.4 | 7.2 |
| Without dependents | 2.4 | 2.8 | 4.4 | 7.8 | 16.1 | 14.9 | 10.0 | 3.6 | 0.3 |
| FY 1985 | | | | | | | | | |
| With dependents | 80.1 | 74.3 | 67.1 | 59.3 | 44.8 | 32.0 | 24.7 | 11.9 | 6.8 |
| Without dependents | 2.5 | 3.1 | 4.6 | 8.5 | 15.7 | 14.2 | 10.5 | 2.9 | 0.3 |
| FY 1986 | | | | | | | | | |
| With dependents | 81.4 | 75.7 | 67.4 | 59.9 | 45.8 | 32.2 | 23.4 | 14.6 | 7.4 |
| Without dependents | 2.8 | 3.2 | 5.2 | 9.1 | 15.1 | 13.6 | 10.3 | 2.4 | 0.2 |
| FY 1987 | | | | | | | | | |
| With dependents | 82.1 | 76.4 | 68.2 | 60.2 | 46.8 | 32.6 | 24.2 | 15.5 | 7.8 |
| Without dependents | 3.2 | 3.5 | 5.4 | 9.1 | 14.4 | 13.5 | 9.9 | 1.9 | 0.2 |